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VOL. CXXXVII.—No. 3553] LONDON: FRIDAY EVENING, FEBRUARY 1, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

G. R.

BY DIRECTION OF THE DISPOSAL AND LIQUIDATION COMMISSION.

The Commission Invites Tenders

for the PURCHASE of the COMPONENT PARTS of about 4000 FREIGHT CARS of Russian Railway Gauge, lying in Canada (approximately 12,000 tons).

The Components are offered for export only in one lot as they lie.

Sale conditions and particulars, together with form of Tender, can be obtained from the Secretary, Disposal and Liquidation Commission, Caxton House, Tothill-street, Westminster, London, S.W. 1, or from Mr. J. E. Francis, 65, Broadway, 10th Floor, New York City. Mr. Francis will furnish the necessary permits to inspect the material.

Sealed Tenders, in the envelopes supplied, should be sent direct to the Secretary, Disposal and Liquidation Commission, so as to be received not later than Noon on 15th April, 1924. 4766

City of Hull Waterworks.

DUNSWELL PUMPING STATION, CONTRACT No. 7.

The Water and Gas Committee are prepared to receive TENDERS from British manufacturers for the CONSTRUCTION and ERECTION of TWO SETS of PUMPING PLANT, each not capable of delivering Five Million Gallons of Water per 24 hours. The plant to consist of Reciprocating Pumps driven by any prime mover—steam, gas, oil, electricity, &c.

Particulars may be obtained from the undersigned on payment of a deposit of Five Pounds, which will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Pumping Plant," must be delivered not later than 10 a.m. on Wednesday, the 20th February, 1924.

By Order,
C. B. NEWTON, M. Inst. C.E.,
Engineer.

Guildhall, Hull,
20th January, 1924. 4773

Egyptian State Railways.

TENDERS are REQUIRED for the CONSTRUCTION of STEEL ROOFS and SHELTER of Alexandria New Station.

Copies of the specification and drawings may be obtained from the Inspecting Engineer, Egyptian and Sudan Governments, Queen Anne's Chambers, Broadway, Westminster, S.W., on payment of £2 2s.

Tenders are to be submitted to the AUTHORITIES IN CAIRO not later than the 1st May, 1924. 4676

Kettering Urban District Council.

WEIGHBRIDGE.

The above Council invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of a 15-TON WEIGHBRIDGE for their Depot situated in Rockingham-road, Kettering.

Further particulars may be obtained from Mr. T. Reader Smith, Surveyor to the Council, Market-place, Kettering.

Tenders, endorsed "Weighbridge," must reach the undersigned not later than Monday, the 11th day of February, 1924.

By order,
JOHN BOND,
Clerk to the Council.

Council Offices, Kettering,
29th January, 1924. 4767

The Madras and Southern Mahratta Railway Company, Ltd.

The Directors are prepared to receive TENDERS for: FIVE LOCOMOTIVES (Mixed, 4-6-0 Type, Metre Gauge), with TENDERS,

in accordance with the specification which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, the 26th February, 1924, and marked, "Tender for Locomotives."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices,
25, Buckingham Palace-road, Westminster, S.W. 1,
30th January, 1924. 4750

Singapore, Straits Settlements.

WATER DEPARTMENT.
ASSISTANT ENGINEER.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER, age 25-30, preferably unmarried, on a three years' agreement, with possible extension. He must have had a good technical education, a regular training as a civil engineer, and have a practical knowledge of Surveying, Levelling and Estimating, and at least three years' experience in works of Water Supply. Preference will be given to an Assistant who has passed the examination of the Institution of Civil Engineers as Assoc. M. Inst. C.E. The Testamur by examination of the Institution of Municipal and County Engineers will be an advantage. Salary 6000 dollars for the first, 7440 dollars for the second, and 7920 dollars for the third year, paid monthly, in dollars, the currency of the Colony, the value of the dollar being two shillings and fourpence sterling. The pay of the appointment for the first year at this rate would be £812. Such local transport allowance as may from time to time be sanctioned by the Commissioners will be paid. Free passage will be provided, with half-pay during the voyage out. The selected candidate must pass a medical examination.—Applications, stating whether married or single, age and place of birth, and giving details of education, training and experience, particularly in Waterworks, and referring to all the above requirements in detail, accompanied by copies (only) of testimonials, and also personal reference, to be lodged with Messrs. C. C. LINDSAY and PEIRCE, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents for the Commissioners (who will give further particulars if requested), not later than Tuesday, 5th February, 1924. 4716

Tees Valley Water Board.

The above Board invite APPLICATIONS for the POSITION of MANAGER to the BOARD.

The candidate appointed will be required to devote the whole of his time to the duties of the office, and must have had experience in a similar position.

Applications, giving particulars of previous experience and stating salary required, accompanied by three recent testimonials, and endorsed "Manager," should be sent to the undersigned not later than Noon on Thursday, February 14th next.

Canvassing in any form whatever will be considered a disqualification.

R. RAINBRIDGE,
Chairman to the Board.

Municipal Buildings,
Middlesbrough. 4724

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Wireless Communication with Lightships.

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Lake Mentz Dam on the Sundays River.

Progress of Mechanical Engineering in the Military Service.

The Turbine Locomotive.

PUBLIC NOTICES

The South Indian Railway Company, Limited,

are prepared to receive TENDERS for the SUPPLY of—

1. STEEL RAILS and FISHPLATES.
2. POINTS and CROSSINGS, &c.
3. CAST IRON POT SLEEPERS.
4. FISH BOLTS, SPIKES, &c.
5. ROOFWORK.
6. MILD STEEL BARS, SECTIONS, &c., for Miscellaneous Purposes.
7. WOOD HANDLES.
8. HEMP and COTTON FABRICS, &c.
9. INDIARUBBER GOODS.
10. PORTLAND CEMENT.
11. YORKSHIRE IRONS.

Specifications and forms of Tender will be available at the Company's offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked, "Tender for Steel Rails and Fish Plates," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 15th February, 1924, in respect of Specifications Nos. 7, 8, 9, 10 and 11, and not later than Twelve Noon on Friday, the 22nd February, 1924, in respect of Specifications Nos. 1, 2, 3, 4, 5 and 6.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of—

10s. for each copy of Specifications Nos. 1, 2, 5 and 6.
5s. " " " " 10 and 11.
2s. 6d. " " " " 3, 4, 7, 8 and 9.

Copies of the drawing may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 4, Victoria-street, Westminster, S.W. 1.

W. B. REYNOLDS,
For Managing Director.

29th January, 1924,
91, Petty France, S.W. 1. 4762

PUBLIC HEALTH ACT, 1875.

Urban District of Letchworth,

HERTFORDSHIRE.
LETCHWORTH MAIN OUTFALL SEWERS AND SEWAGE WORKS.

The Urban District Council of Letchworth, acting as the Sanitary Authority for the said District, are prepared to receive TENDERS for the LAYING of 24in. and 18in. OUTFALL, and certain smaller SEWERS, and the CONSTRUCTION of OUTFALL WORKS at Letchworth.

Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from Monday, the 11th of February, 1924, until Friday, the 22nd February, 1924, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of Five Guineas, which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.

The successful tenderer will be required to execute a contract deed, the draft of which may be seen at the offices of the Consulting Engineers when the drawings are inspected.

Tenders must be on the official form, each Tender in a sealed envelope, marked "Tender for Outfall Sewers and Works." Tenders must be accompanied by the general conditions and specifications as issued by the Consulting Engineers.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Council does not bind itself to accept the lowest or any Tender.

Tenders must reach the undersigned by 9 a.m. on Friday, the 7th of March, 1924.

Given under my hand the 25th day of January, 1924.

GEORGE BROWN,
Clerk to the Urban District Council.

Council Offices:
Broadway Chambers,
Letchworth Herts. 4758

PUBLIC NOTICES

The Great Indian Peninsula Railway Company, 48, Copthall-avenue,

London, E.C. 2, invite TENDERS for—

1. BOOFWORK .....Fee 10s.
2. CAST IRON CHAIRS ..... " 10s.
3. STEEL SPIKES ..... " 5s.

Tenders are due by 11 a.m. on 12th February, 1924. Tender forms obtainable at above address. Fees not returnable. 4786

Burgh of Oban.

SALE OF STEAM GENERATING PLANT.

The above Council have FOR SALE TWO Babcock and Wilcox BOILERS, evaporating 7000 lb. per hour each; 96-Tube Green's ECONOMISER, Hall FEED PUMP, STEAM PIPES, VALVES, &c., working pressure 165 lb.; TWO 100 H.P. Howden H.S. COMPOUND VERTICAL STEAM ENGINES, direct-coupled to 60-K.W. 500-Volt D.C. 6-pole Shunt GENERATORS, with Spare Armature. The whole plant in first-class condition.

Full particulars from BURGH ELECTRICAL ENGINEER, Electricity Works, Oban. 4763

City of Carlisle.

The Corporation Invites APPLICATIONS for the POSITION of CLERK OF WORKS, in connection with the proposed Reconstruction of the Caldew Bridges. Applicants must have a thorough practical knowledge of Foundations, Masonry and the Fixing of Steelwork. The work is estimated to continue between 12 and 18 months. Wages, £6 per week. Applications, stating age and experience, together with copies of three recent testimonials, endorsed "Clerk of Works," to be delivered to the undersigned by February 20th, 1924.

HENRY C. MARKS, M. Inst. C.E.,
City Engineer and Surveyor.

18, Fisher-street, Carlisle,
29th January, 1924. 4781

SITUATIONS OPEN

WANTED, in Large Structural Works, South Wales, ASSISTANT to WORKS MANAGER; young, energetic, with experience of work in Constructional Shops, and suitable technical knowledge.—Address, stating age, experience, qualifications, whether married or single, &c., 4754, The Engineer Office. 4754 A

WANTED, WORKS MANAGER, to Control Engineering Works manufacturing Steam Engines, Steam Boilers, and Internal Combustion Engines. Essential to have had experience in the above and also Iron and Brass Foundry; must be good organiser. Applications from men with suitable experience only will be considered. State age, experience, and salary required.—Address, 4780, The Engineer Office. 4780 A

A JUNIOR ENGINEERING ASSISTANT is REQUIRED in the Drawing-office of an important municipal undertaking in the Midlands. The successful applicant must be a good Draughtsman, and have had a suitable training in Waterworks Engineering and Surveying. Preference will be given to Associate Members or Students of the Institution of Civil Engineers.—Applications, stating age, experience, qualifications and salary required, together with copies of three recent testimonials, to be addressed 4757, The Engineer Office. 4757 A

ENGINEERS' TRAVELLER WANTED for London and South Coast. State experience and salary required.—E.921, c.o. Deacon's, Leadenhall-street, E.C. 3. 4695 A

FUEL SUPERVISOR WANTED for Factory. Experience with Stirlings and Lancashires; knowledge of Heat Balances and Theory of Combustion essential. State salary.—Box 1034, Morison's Advertising Agency, Hull. 4722 A

SITUATIONS OPEN (continued)

JAPAN AND BRITISH INDIA.—APPLICATIONS are INVITED for POSITION of REPRESENTATIVE in Japan and British India respectively, for large High-grade Steel Works. Applicants must have good technical knowledge of High-speed and Tool Steels, and good business experience; must also be personally acquainted with local conditions.—Write, giving full particulars of experience, &c., 4680, The Engineer Office. 4680 A

MANAGER REQUIRED to Take Charge of Hydraulic Engineering Works; must have up-to-date experience in Design, Manufacture and Sale of Hydraulic Machinery. Applications from first-class and experienced men only will be considered, and should state age, details of experience and qualifications and salary required.—Address, 4768, The Engineer Office. 4768 A

RATE FIXER WANTED for Marine Engine Shop. State age, experience, and wages expected and if presently employed.—Address, P8614, The Engineer Office. P8614 A

REPRESENTATIVE WANTED to Call on Consulting Engineers, Railways, Electrical and Mechanical Engineering Shops, &c.; age about 25-35; experienced in the Sale of Steel Castings and Forgings, Railway Material and allied lines.—Address, stating details of previous experience and salary required, to 471, c.o. Judds, 97, Gresham-street, London, E.C. 4750 A

WORKS MANAGER REQUIRED for Constructional Steelwork Engineers in London District. Must be first-class man with thorough knowledge of the work in all its branches. Only those having held similar position need apply.—Address, stating age, salary required, experience, &c., 4778, The Engineer Office. 4778 A

WANTED, First-rate DRAUGHTSMAN, used to Designing Bridges and Structural Work. Good salary to competent man.—Apply, by letter only, stating age, experience, and salary required, to JOHN BUTLER and CO., Ltd., Stanningley Ironworks, Leeds. 4787 A

WANTED, LOCOMOTIVE DRAUGHTSMAN, North-Eastern District, experienced in the preparation of Sketch Designs and Estimates.—Address, giving age, experience and salary, 4779, The Engineer Office. 4779 A

WANTED, Reliable DRAUGHTSMAN; also JUNIOR, accustomed to Steel Constructional Work, Hoppers, Elevators, &c., in connection with Roadstone Machinery and Plant.—Apply, by letter, giving experience and salary required, to J. DAWSON FAWCETT (Darlington), Ltd., Haughton Engineering Works, Darlington. 4784 A

DESIGNER REQUIRED, Age 25-30; must have had several years' continuous experience in Designing. Permanency for good man.—Apply, stating experience and salary required, to CHIEF DRAUGHTSMAN, Redpath, Brown and Co., Ltd., Trafford Park, Manchester. 4759 A

DRAUGHTSMAN for London District, with a knowledge of Tools and Planning Work and Small Parts. State experience, age and salary required.—Address, 4794, The Engineer Office. 4794 A

DRAUGHTSMEN (SENIORS). First-class Men only, for Switchgear, REQUIRED by London firm. Good money for right men.—Address, 4640, The Engineer Office. 4640 A

DRAUGHTSMEN.—THE BRITISH THOMSON-HOUSTON CO., Rugby-lane, Willesden, N.W. 10, INVITE APPLICATIONS from first-class SWITCHGEAR DRAUGHTSMEN.—Write, stating age, salary and experience, to CHIEF DRAUGHTSMAN. 4641 A

DRAUGHTSMEN, THREE JUNIOR, REQUIRED IMMEDIATELY by Reinforced Concrete Specialists. Designing experience not required; must be able to Detail to Designer's Instructions; previous experience desirable. State age, salary expected.—Address, P8617, The Engineer Office. P8617 A

DRAUGHTSMEN WANTED by London Firm, with first-class experience in the Design and Lay-out of up-to-date Switchgear. Good salary for really capable men.—Write, stating age, experience and salary required, 4630, The Engineer Office. 4630 A

DRAUGHTSMAN WANTED. Must Have Good general training with experience in the Design of Heavy Machinery, for works near Manchester. In applying state experience, age and salary expected.—Address, P8580, The Engineer Office. P8580 A

DRAUGHTSMEN WANTED for London Office. Capable of Designing Structural Steelwork, Mechanical Plant, &c.—Write, stating age, references, qualifications and salary required, to "A. F." c.o. Street's, 6, Gracechurch-street, E.C. 3. 4756 A

ELECTRICAL ENGINEER - DRAUGHTSMEN WANTED by Firm in N.W. London for the Preparation of Connection Diagrams for Power Station Switchgear. First-class men with good technical training only need apply.—Write, stating age, experience and salary required, 4638, The Engineer Office. 4638 A

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SITUATIONS OPEN (continued)

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED; none but experienced men need apply. State full particulars, age, salary required.—THE CLEVELAND BRIDGE and ENGINEERING CO., Ltd., Darlington. 4453 A

MECHANICAL DRAUGHTSMAN REQUIRED in Westminster Office; must be thoroughly reliable and capable, with first-class experience in Colliery Plant and Lay-out Details.—Address, giving age, experience, and salary required, to 4788, The Engineer Office. 4788 A

REQUIRED IMMEDIATELY, INSTRUMENT DRAUGHTSMAN, with not less than three years' Drawing-office Experience in Telephone, Telegraph or Wireless Work. Starting salary from 40s. to 50s. per week, plus Civil Service bonus, giving a present total of from £3 8s. to £4 1s. 6d. p.w.; ex-Service man preferred.—Apply to SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 4765 A

SENIOR DRAUGHTSMAN REQUIRED. Accustomed to Taking Charge of Large Contracts; permanency for good man.—Apply, stating experience and salary required, to CHIEF DRAUGHTSMAN, Redpath, Brown and Co., Ltd., Trafford Park, Manchester. 4700 A

WANTED, PATTERNMAKER. Permanent Situation, experienced men only.—Apply, P. J. SMITH, 2A, Wyvratt-street, Gorwell-road, E.C. P4701 A

SITUATIONS WANTED

WANTED, A POSITION as Works Manager, Chief Rate Fixer or Production Engineer; thoroughly conversant with present-day methods and requirements; rate-fixing, planning and factory organisation; accustomed to control labour, tactful, energetic; excellent credentials.—Address, P8592, The Engineer Office. P8592 B

ADVERTISER, with Long Experience Overhauling and repairing automatics, semi-autos, presses and dies, DESIRES APPOINTMENT; could undertake inspection for export, &c.—Address, P8616, The Engineer Office. P8616 B

A.M.I.C.E., A.M.I. Mech. E. (Chartered Civil Engineer), aged 34 yrs., DESIRES CHANGE. Thorough knowledge of foundry and general engineering work, estimating, works administration, costing, &c.; direction of contracts through foundry and machine shops. Any progressive position considered; not afraid of hard work.—Address, P8622, The Engineer Office. P8622 B

CONTRACTORS' AGENT, with 16 Years' Experience in responsible charge large dock and public works contracts, OPEN TO RE-ENGAGEMENT.—Address, P8491, The Engineer Office. P8591 B

ENGINEER MANAGER or SUPERINTENDENT, mechanical, marine, or industrial engineering, English (38), single. Accustomed to tackle and get over hard jobs under difficulties. Good organiser and executive; tact, energetic, hard worker. Several years' experience design, construction and operation, oil refineries, ships and machinery and general engineering plants. Superintendent shipping co.'s and Lloyd's surveyor. Complete control large staffs and labour, knows how to obtain best results. Fluent Spanish, Italian, French and other languages. M. Inst. N.A. &c. Excellent refs. Open to ACCEPT POSITION anywhere after Feb. 15, 1924.—Address, P8606, The Engineer Office. P8606 B

ENGINEER, with Technical and Commercial Experience, good knowledge of production methods and first-class connection, is OPEN to OFFERS.—Address, P8596, The Engineer Office. P8596 B

ENGINEER (24), A.M.I.C.E. exam., 5 Years' Pupil, locomotive, millwright, &c., B.O. experience, SEEKS POST under Civil or Mechanical Engineer at Home or Abroad; knowledge of French and Spanish.—Address, P8575, The Engineer Office. P8575 B

ENGINEER (28), Technical College Training, Experience erection and maintenance of boilers, turbines and reciprocating engines, refrigeration and electrical plant. First-class B.O.T. certificate. Trained and experienced in engineering salesmanship, SEEKS APPOINTMENT, preferably sales of plant maintenance.—Address, P8612, The Engineer Office. P8612 B

ENGINEER (31) SEEKS SITUATION, Good All-round mechanical experience, maintenance of small works plant or power station, with crude oil engines, steam or gas engine, fitting and turning. UNDERTAKE all REPAIRS. Moderate salary if permanent.—Address, P8609, The Engineer Office. P8609 B

ENGINEER (42), B.Sc., A.M.I.E.E., Wide Electrical experience, 10 years charge electrical installation on large chemical works, used to lay out, operate and maintain A.C. and D.C. plant, some years essential experience, DESIRES APPOINTMENT.—Address, P8601, The Engineer Office. P8601 B

ESTIMATOR, Rate-fixer, Planner, &c., REQUIRES POSITION. Sound practical man, with initiative. Ten years' experience light and heavy tooling, fitting, toolmaking, &c. Accustomed to mass production and general engineering on up-to-date methods. Refs.—Address, P8610, The Engineer Office. P8610 B

MECHANICAL ENGINEER, with Experience as manager of general engineering works and boiler works, used to control of office, estimating, interviewing, maintenance and repairs, is DESIROUS of OBTAINING SIMILAR ENGAGEMENT.—Address, P8593, The Engineer Office. P8593 B

MECHANICAL ENGINEER with Good All-round experience of general engineering, as foreman, cost clerk and manager, SEEKS responsible POST in any capacity, any district.—Address, P8618, The Engineer Office. P8618 B

POSITION WANTED as WORKS ENGINEER or FOREMAN MILLWRIGHT, aged 37, excellent references, had entire charge as above of large and important engineering works.—Address, P8598, The Engineer Office. P8598 B

REINFORCED CONCRETE ENGINEER (39), Eighteen years' experience in charge of works in London, Japan, Singapore, West Africa and India, SEEKS similar POST. Excellent testimonials.—Address, P8604, The Engineer Office. P8604 B

STEEL SMELTING.—POSITION REQUIRED as PRACTICAL MANAGER of OPEN-HEARTH PLANT, home or abroad. First Hand or Sample Passer. Good practical experience in English and foreign steel works. Distance no object.—Box "X," Kidd's Advertising Agency, Middlesbrough. 4771 B

YOUNG ENGINEER DESIRES POSITION at home or abroad, steam, gas, water, petrol. Good experience and references.—Address, P8603, The Engineer Office. P8603 B

DRAUGHTSMAN (23) REQUIRES SITUATION, London preferred; apprenticeship served, good references and D.O. experience; motor work preferred.—HERBERT, 42, Amberley-road, Bush Hill Park, Enfield, Middlesex. P8597 B

DRAUGHTSMAN (28), with 9½ Yrs. Practical Exp. and 2 yrs. technical training, SEEKS POST at gen. mech. engineers.—" A.," South View, Brenzett, Kent. P8621 B

CLERK SEEKS RE-ENGAGEMENT. Knowledge cost, wages, &c., excellent character and testimonials; provinces preferred.—Address, P8607, The Engineer Office. P8607 B

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Engineering undertakings reorganised by specialists.

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PARTNERSHIPS and ACTIVE DIRECTORSHIPS WANTED in Mechanical, Constructional, Electrical Engineers, &c., for Clients with technical experience and capital from £1000 to £20,000.—GILBERT and PRATT, 18 Walbrook, London, E.C. 4. Ex. C

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric. Inter. and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc., (Honours), Assoc. M. Inst. C.E., M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—9/11, Trafford Chambers, 58 South John-street, LIVERPOOL. Ex. B

ENGINEERING EXAMINATIONS.—Day, Evening or Correspondence Courses of Preparation for all Examinations. Thousands of successes during the past eighteen years.—G. P. KNOWLES, M.B.E., B.Sc., A.M.I.C.E., &c., 39, Victoria-street, Westminster, S.W. 1. Ex.

ENGINEERING SALES MANAGERS.—Our Special Course of Training qualifies students for posts of unlimited scope in this lucrative field. We are prepared to arrange introductions between employers and our trained candidates.—Apply, The INSTITUTE of ENGINEERING SALESMANSHIP, 323, Oxford-road, Manor. P8435 B

PUPIL.—WANTED, a SIX MONTHS' COURSE in PRACTICAL SURVEYING and LEVELLING for boy of 18; give particulars and fee.—Address, P8573, The Engineer Office. P8573 B

SURVEYING and LEVELLING.—Brilliant Opportunity to acquire thorough practical instruction on work.—Address, E. MOREL, Hollybank, Woking. P8309 E

TUITION BY POST.—Inst. C.E. and I. Mech. E. Passed now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £2 2s. Write for particulars.—PENNINGTONS, University Tutors, 234, Oxford-road, Manchester. Estab. 1876. Ex.

AGENCIES

AGENCY.—Old-established Firm of General Engineers, with showroom and connection with Government Departments, railways, shippers and consulting engineers, REQUIRES AGENCY for high-class Machinery in London and district.—Address, P8611, The Engineer Office. P8611 D

EGYPT.—FIRM of ENGINEERS are DESIROUS of COMMUNICATING with a BRITISH MAKER (not already represented in this country) of first-class High-compression Four-cycle Horizontal Type CRUDE OIL ENGINES.—Address, THOMAIDES and VENIERI, Rue Stamboul 18, Alexandria, Egypt. 4747 D

ENGINEER, with Extensive Personal Connection amongst the textile works, collieries and chemical works in Yorkshire, already representing an important firm of electrical engineers, DESIRES AGENCY for leading firm of Mechanical Engineers; highest references given.—Address, P8599, The Engineer Office. P8599 D

ENGINEERING FIRM, London District, with specialities required by all steam plant users, leading engineers, &c., REQUIRE LIVE REPRESENTATIVES in Yorkshire, South Wales and West of England. Only established firms with best references need apply.—Address, 4780, The Engineer Office. 4780 D

LARGE FIRM in London, Occupying Large Building in the City, with warehouses, showrooms, having travellers throughout England, offices and representatives abroad, including Russia, DESIRES to ACT as DISTRIBUTING BUYING AGENTS in England and abroad for large manufacturers in the iron and steel industry, hardware and tools.—Address, P8606, The Engineer Office. P8606 D

LONDON ENGINEERS, with Valuable and Extensive connection, specialising solely on export of building and constructional materials, SEEK ONE ADDITIONAL EXPORT AGENCY.—Address, P8574, The Engineer Office. P8474 D

LONDON MERCHANTS, Doing Extensive Business in Steel Castings, Forgings, Wheels and Axles, Railway Trucks, &c., WOULD ENTERTAIN AGENCIES for other suitable manufacturers in conjunction therewith. Particularly interested in establishing relations with Rolling Mills catering for export trade.—Write, Box 472, c.o. Judds, 87, Gresham-street, London, E.C. 4751 D

MANUFACTURERS REQUIRE a SELLING AGENCY for Metallic Feed Pump Packing.—Address, 4789, The Engineer Office. 4789 D

YOUNG Practical, Well-educated ENGINEER, with City office, DESIRES an ADDITIONAL AGENCY for London. Ambitious, good appearance and businesslike.—Address, P8615, The Engineer Office. P8615 D

MISCELLANEOUS

WANTED, LARGE FIRM of BOILERMAKERS to UNDERTAKE the MANUFACTURE in England of WATER-TUBE BOILER, which is in keen competition to Babcock and Wilcox, Stirling and Thompson boilers; all drawings and technical details supplied; guaranteed saving coal consumption 8 to 10 per cent.; maintenance cost decreased in comparison with types mentioned.—Address, 4785, The Engineer Office. 4785 I

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For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

The Elevation of Naval Guns.

ACCORDING to messages from Washington, the Naval Appropriation Bill for the coming fiscal year again provides a large sum for refitting the older battleships of the United States Navy, the intention being to equip them with additional protection against plunging gunfire, aerial bombs and torpedoes, besides increasing the elevation of their main armament and converting the coal-burning ships to oil fuel. A proposal to this effect was adopted by the legislative bodies in December, 1922, a sum of 6,500,000 dollars being voted to cover the initial cost. But on its becoming known, a month or two later, that the information supplied to Congress by the Navy Department, as to the elevation and range of British heavy naval guns, was inaccurate, this particular vote was held in abeyance, and has not yet been released by the Treasury. The total cost of the modernisation programme is estimated at 30,000,000 dollars. Next to the conversion of coal-burning ships to liquid fuel, the American naval authorities attach most importance to increasing the firing angle of the turret guns of the ships in question—thirteen in all. Four of these are armed with 12in. and nine with 14in. guns, the mountings in each case permitting of only 15 deg. of elevation, equivalent to extreme ranges of 20,000 and 22,000 yards respectively. Of the five remaining ships of the U.S. battle fleet, all can discharge their guns at an angle of 30 deg., which enables the three "Marylands," armed with 16in., 45-cal. pieces, to range up to 32,000 yards, and the California and Tennessee, mounting 14in., 50-cal. guns, up to 34,000 yards. Except at these great distances, the British battle fleet has an advantage in length of range, owing to all our ships, from and including the "Orion" class, having had their turret mountings designed for an elevation of 20 deg., whereas American naval designers did not see fit to go beyond 15 deg. in any of their pre-Jutland ships. If a mean were struck between the two present-day fleets, it would be found that the average range for the eighteen American ships is 25,250 yards, while the average for the twenty-two British ships is 24,368 yards.

Three Railway Accident Reports.

THE reports to the Ministry of Transport on three railway accidents were issued at the end of last week. The first related to a head-on collision on October 19th between an arriving passenger train and a light engine, which had moved forward against a signal and fouled the arrival line. In this case the driver of the light engine relied upon his fireman, and was misled by what the fireman said. The second report was upon a collision during a dense fog on November 9th, when a slow passenger train standing on the up platform line at Doncaster was run into by another passenger train. Owing to the fog, the driver of the second train could not be verbally warned by the signalman of the presence of the first train, and the warning had to be given by the fogman. The latter put a detonator on the rail, but the driver claimed that it was not sufficiently far back, and that he was unprepared to find the first train only 92 yards in front of him. That this was a reasonable excuse is suggested by the recommendation of Major Hall that in view of the short distance between the two signal-boxes concerned, only one train at a time should be allowed there during foggy weather. The mishap to a train at Palace Gates, Wood Green, on November 22nd, formed the subject of the third report. The train was what is known as an auto-train, the driver being in the leading compartment and the fireman on the engine, which was in the rear. At the previous stopping-place the train over-ran the platform, and had to set back. The fireman, instead of waiting for the driver to apply steam, removed the pin from the air-operated control rod and manipulated the regulator himself. The driver was unaware that he had done so and that he had failed to restore the pin. Consequently, the regulator would not shut when the train approached Palace Gates, and the train ran through the station, into the sidings and came into collision with two engines in the locomotive coal yard.

French Trade.

ONE of the manifestations of the French disappointment over the collapse of the franc is taking the form of a proposal to boycott foreign goods and products. The results of that boycott, if carried out, may be foreshadowed by an analysis of the returns of foreign trade during the past year. Those returns are probably amongst the most favourable that France has ever experienced. Both imports and exports largely increased as compared with 1922, and while the weights of exports were less than one-half the weights of imports, the values were nearly the same, this being due mainly to the considerable imports of fuel and to the heavy increase in the exports of manufactured goods. The purchase of raw material and fuel, representing about two-thirds of the total value of imports, does not mean any impoverishment of the country, and there is a distinct accession of wealth when the value of manufactured goods exported is equal to just one-half of the total imports. To put it another way, France exported last year four times as much manufactured goods as she imported. While the purchases of foreign manufactured goods showed only a small increase, the exports, amounting to 16,232 million francs, were 3960 million francs in excess of those for 1922. After taking into account "invisible exports," which do not figure in the returns, it is assumed that France has secured a "balance of trade" by largely importing raw material and exporting finished products. This extremely favourable position will certainly not resist any boycott of foreign goods.

Naval Wireless Regulations.

NEW regulations governing the use of wireless telegraph or telephone apparatus by foreign warships in British harbours have been issued. Among other things, these regulations state that foreign war vessels lying in a naval port or in any harbour which is close to a naval port, must obtain permission from the senior naval officer at the naval port to use their apparatus. The system of transmission, wave lengths and the times at which it is proposed to send out messages must also be specified. Foreign warships lying in any harbour which is not close to a naval port must conform to certain regulations. Transmissions on a wave length of 600 m. are forbidden, except for the purpose of making or answering signals of distress. Interference with Naval, Army or Air Force signalling must be avoided, and transmissions must be discontinued at the request of any naval authority, the port authorities or any fixed shore station.

Aeronautical Research.

WE are informed by the Air Ministry that a change has been made in the arrangements for the control of aeronautical research. Hitherto, the Director of Research has been responsible under the Air Member for Supply and Research for both scientific research on aeronautic matters and its practical application to the technical developments of aircraft, engines, and accessories. The rapid development of the science and the requirements of the Royal Air Force have now made necessary a re-allocation of the responsibilities of the Director of Research. From April next this appointment will lapse, and the control of one side of the work will be transferred to a Director of Scientific Research, while that of the other side will be assigned to a Director of Technical Development. Both the new Directors will serve under the Air Member for Supply and Research. It is expected that the appointments to the new posts thus created will be announced later. The effect of this reorganisation will be to give to scientific research the free scope for its development which the recent growth of service and civil flying renders necessary.

Standardisation of Colliery Requisites.

THE British Engineering Standards Association has undertaken, at the request of the Mining Association of Great Britain, the standardisation of colliery requisities. The Mining Association has, we understand, contributed certain funds to enable the work to proceed on an adequate basis, and a fully representative committee will be set up under the chairmanship of Mr. Evan Williams, the President of the Mining Association. In order that full use may be made of the knowledge possessed by those in daily contact with the apparatus and equipment, local committees are to be instituted, and by that method of working it is hoped that rapid progress will be made. Such committees, we learn, will concentrate their attention on a limited number of the more important questions, such as pit tubs, rails and rope sheaves, of which there are at present far too great a variety of types in existence. The standardisation of the various articles and equipment used at a colliery will be followed with keen interest by all sections of the engineering trade. The yearly cost of replacement of such parts extends into several millions of pounds, and even a small percentage saving will represent a sum which is of sufficient importance to be reflected in the cost of producing coal.

Track Renewals and Trackless Vehicles.

IN a report prepared by Mr. R. H. Wilkinson, the manager of the Bradford Corporation Tramways, it is suggested that as soon as the present tramway tracks wear out, the existing routes be converted for trackless cars. Fifteen years is taken as the average life of the track, and the cost is spread over that period. It is estimated that the cost of making the change would be £603,000, made up as follows:—Overhead line, £93,000; return feeders, £128,000; reinstatement of the road, £382,000. No allowance is made for the cost of cars as they would in any case have to be provided to maintain the present system. If the latter were to be continued, an average expenditure of £70,000 per year on the upkeep of the track must be assumed, which amounts in fifteen years to £1,050,000. On the railless side an amount of £70 per year for road maintenance costs must be allowed for each vehicle, and for 270 vehicles this reaches a yearly sum of £18,900, which, compared with track renewals and maintenance at the aforementioned rate of £70,000, shows a yearly saving of £51,000. The report recommends that on the steep gradients single-deck vehicles should be used both for the sake of economy and safety. It is unfortunate, in view of the scheme we have outlined, that what might easily have been a serious accident took place at Bradford on Saturday evening last. A trackless vehicle was proceeding along the Canal-road towards the city, when the steering gear suddenly failed. Although the driver immediately applied his brakes, the vehicle mounted the pavement, broke through a wire fence, and, after crossing the towing path, was only brought to a standstill with its front wheels overhanging the canal. Happily the ten passengers and the driver escaped with nothing worse than a severe shaking.

The Empire Airship Scheme.

THE recent French disaster with the airship Dixmude and the storm experiences of the American airship Shenandoah have not deterred the enthusiasm of Commander Burney and the supporters of the Empire Airship Service. Writing recently in the *Manchester Guardian*, Major Robertson states that the new airship plans are well advanced and are quite different from the designs which have hitherto been constructed. In war-time airships, a factor of safety of 1.5 was sometimes adopted, but the Burney ships, it is stated, will be constructed with a factor of safety of 4. The propelling power will be derived from seven engines, each of 600 horse-power and a ship speed of 80 miles per hour is anticipated. Contrary to previous general practice, the fuel used will be paraffin and hydrogen. The use of the latter gas will enable a considerable saving to be effected, since under general running conditions large quantities of gas have to be blown off to waste. The experimental engines have been built as single-cylinder units, and have passed preliminary tests. We learn that the new engines will be somewhat heavier than the usual petrol engine for aero-work, but they are expected to run much cooler.

French Coal.

THE measures being adopted by the French Government to stabilise the franc provide for the cheapening of the cost of living, if that be possible, and the first thing to be done is to reduce the price of French coal to home consumers. At the urgent insistence of the Government, the coalowners have agreed to a reduction of 3f. a ton, although they made it clear that their action was dictated by patriotic motives, and was not justified by the increasingly heavy charges which have been imposed upon the colliery industry during the past few years. At the same time, the exportation of coal and coke has been prohibited. Until recently, Belgium has been taking a fair amount of industrial coal in exchange for household fuels, and quantities have been consigned to Switzerland and Italy. These foreign consignments have now been suppressed, so as to permit of home consumers profiting from the lower prices and reducing, at the same time, the purchases of British coal.

The Railway Strike.

AT 4.30 a.m. on Tuesday, after more than twelve hours' continuous negotiation, the railway strike was settled. The railway managers and the Executive Committee of the Associated Society of Locomotive Engineers and Firemen met on Monday afternoon at Euston, and with the assistance of the Trades Union Congress General Council's Mediation Committee, reached an agreement which led to an immediate resumption of work being ordered by the Union's leaders. In the terms of settlement it is made clear that the companies do not regard, and never have regarded, the acceptance of the decisions of the National Wages Board as obligatory upon all parties to the proceedings, but that in the particular instance which led to the strike they were justified in giving effect to the Board's decisions. To meet the contention of the Union that the immediate application of the full terms of the decision would involve serious hardship to certain sections of the men, the agreement provides that the basis of payment for mileage working shall be 130 miles for a day's pay from the date of operation of the decision until the beginning of the first pay week in July, 140 miles thereafter until the beginning of the first pay week in January, 1925, and 150 miles subsequently, unless otherwise agreed in the interval. Mileage in excess of the stipulated figure is to be paid for at the rate of one hour's pay for every 15 miles. Agreement was also come to regarding the payment of certain engine-drivers engaged on shunting. The companies undertook that there should be no dismissals arising out of the application of the decision, and to reinstate, as soon as possible, all men presenting themselves for work within a reasonable time without loss of seniority. The strike thus came to an end eight days after it began. The restoration of the normal train services was at once put in hand, and by Wednesday had been largely accomplished so far as passenger traffic was concerned.

Pneumatic Grain Elevators.

No. IV.*

By Professor W. CRAMP, D.Sc., and A. PRIESTLEY, M.Sc.

(15) General Method for Design of Plants.

Suppose a plant is required to lift a load L of 30 tons per hour. By the method described we should first plot a number of curves like those in Fig. 6 *ante* and analyse them as in Table IV *ante*.

We notice that variation of the pipe area F *alone* makes little difference to the other variables, with the exception of L. We may therefore choose F, so that it will give us the required L, when $\frac{L}{F}$ has been determined. (The pipe must, of course, be of a practicable size for handling.) Thus, in Table IV. we should rule out Cases 3 and 4, since in our assumed plant L is to be 30 tons per hour, and this would lead to a very high load density in so small a pipe.

Suppose that the vacuum is, for practical reasons, not to exceed 40 cm. of mercury. This rules out Case 6. Suppose, again, that the nozzle velocity is not to fall below 15 m. per second.† This rules out Case 2, and we are left with Cases 1 and 5. The load L in Case 5 is about what is wanted, but the power is greater than that in Case 1 in the ratio of .45 to .17, owing to the high air velocity V_a in Case 5. This would indicate that we should work nearer the lower velocity and lower load density $\frac{L}{F}$ of Case 1, obtaining the requisite L by increasing the pipe area F.

Such is the general method. It need hardly be mentioned that in Table IV. only two values have been taken for each of the variables n, V_a and F, and that many intermediate values must be tried. After a little practice, however, in the drawing of curves like those in Fig. 6, the designer will know from experience what the approximate values of the variables are likely to be, and it will be unnecessary to draw more than three or four curves.

(16) Use of "Auxiliary Air" Inlet in Nozzles.

Consider Cases 3 and 4, Table IV. In Case 3 the vacuum is 20 cm., which is certainly not excessive. In Case 4 it is 34 cm., which is higher than current practice, and would usually be ruled out as excessive for a normal working vacuum. The cause of this high vacuum in Case 4 is the nozzle constant n, which has the value .05, resulting in a load of 10.1 as against 5.4 tons per hour in Case 3. It is clear from this example that, if we wish to keep the vacuum within limits, we shall, in certain cases, have to reduce the natural "drawing-power" of the nozzle by artificial means. This is often effected by surrounding the nozzle with a sleeve, as indicated in the sketch, Fig. 7 so

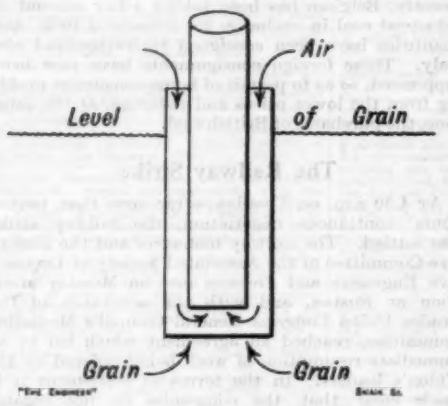


FIG. 7

that part of the air entering the nozzle does so freely, without passing between the grains. The amount of air entering at the top of the sleeve may be regulated by a valve.

This method of working is not economical, and is only imposed by the necessity of keeping the vacuum within bounds. Comparing Cases 3 and 4 again, we see that the capacity (tons per hour) of the plant is seriously diminished by the reduction of the nozzle constant, while the power per ton per hour is actually raised. *If plants could be designed to work at higher vacua than are now common, there would be a gain both in capacity and efficiency.*

(17) Minimum Nozzle Velocity to Lift Grain.

It has been seen that the nozzle velocity must not fall below a certain minimum value, which it is important to determine, as it is one of the fundamental constants for purposes of design. In carrying out the efficiency experiments, the minimum air velocity was determined, which was just sufficient to draw all the grain into the pipe, as fast as it was supplied to the small hopper surrounding the nozzle.

From these data Table V. has been compiled. We have taken—

$$V_{a_o} = \frac{p}{p_o} \cdot V_a$$

$$n = \frac{L}{F_o} \div V_{a_o}$$

The values of p, p_o, V_a and load density $\frac{L}{F_o}$ are taken from the tests.

Table V.—*Minimum Velocity to Lift Grain.*

(Wheat $\frac{w}{a} = 54$.)

Experiment.	$\frac{L}{F_o}$ tons per hour per sq. cm.	V_{a_o} (minimum), metres per sec.	n.
1	.077	13.9	.0055
2	.132	12.7	.010
3	.207	10.7	.019
4	.269	12.5	.022
5	.350	16.8	.021

Starting with the very small loading of Experiment 1, the minimum nozzle velocity was 13.9 m. per second, and this value fell to 10.7 m. per second when the loading had risen to .207 ton per hour per square centimetre of nozzle area (the nozzle was of the same area as the pipe, viz., 18 square centimetres). This fact seems natural when it is remembered that V_{a_o} is calculated on the full area of the nozzle, whereas the presence of the entering grain reduces the effective area of the nozzle, and therefore increases the real air velocity. The blocking effect is increased as the load density $\frac{L}{F_o}$ becomes greater. In Experiments 4 and 5 this law seems no longer to be followed, but the minimum V_{a_o} increases as the load density increases. We must notice, however, that in Experiments 4 and 5 the nozzle is now exerting its full drawing power, as is shown by the fact that n has risen to .022, which is the value of the constant for this nozzle placed in a vertical position.

The increased nozzle velocities of Experiments 4 and 5 are therefore probably more than are sufficient merely to lift a grain when once it has entered the nozzle, but are necessary in order *to draw towards the nozzle* all the grain which is being supplied to the hopper.

The values of the minimum velocity for various kinds of grain must be determined by further experiment. In practice, it might be found unsafe to adopt the values given in Table V., experiments 1–3, these experiments having been made under favourable conditions, with plant leakage reduced to a minimum.

The possibility of using a *constricted nozzle* must also be kept in mind. If the actual V_{a_o} in such a nozzle were kept unaltered, the air velocity in the pipe might possibly then be made lower (if desirable for efficiency) than it could have been with a nozzle of the full area of the pipe. We have seen already that, within limits, the size of orifice makes little difference to the nozzle constant.

It will be seen that there is much work to be done in connection with the nozzle constants here put forward, and that they play a most important part in proportioning the whole plant. The values given will serve as a guide, and by working along similar lines manufacturers may soon acquire the results necessary to construct tables covering wider ranges. At this point we are obliged to leave the matter in their hands, having, as we hope, succeeded (*a*) in setting forth the principles upon which these plants depend, (*b*) in deriving expressions for the vacuum and velocities, and (*c*) in putting forward a rational basis for future designs.

(18) Application of the Formulæ to Other Materials and Media.

So long as air is to be used as the medium for conveying the material, the application of the foregoing work is comparatively simple. The equations of importance to the designer are (23), (24) and (25). Of these, the last depends upon the determination of n by means of experiments similar to those described in Sec. (13), which is not a formidable undertaking. Equations (23) and (24) are derived from (20) and (12) respectively, and depend in turn upon the accurate determination of the three constants characteristic of the material, viz.:—w, a and β. Of these, w is easily measured, and in the Society of Arts paper already referred to, Professor Cramp gave details of the method that he used for obtaining a, and he added a table giving values for six materials other than Manitoba wheat. This range can easily be extended; but it is also worth while remarking that there is a rational basis for a which is dealt with below; so that even without specific tests its value might be predicted with reasonable accuracy in some cases, though it is better to rely upon experimental evidence.

With regard to the value of β, we have already shown that there is a rational basis for the form

$$\beta = 1 + C V_f^2/\sqrt{L},$$

but we think that C will vary widely with different materials, and its determination involves far more elaborate apparatus and experiments than those required for a. Fortunately, however, β is of much less importance than a in the final equations; in so much that if data for the determination of β were unobtainable, a first approximation of considerable value to the designer can still be obtained by writing $\beta = 1$ in the derivation of equations (23) and (24).

Thus, for any material to be elevated by a current of air, the three main equations are derived; for there is no reason to suppose that the last two terms of equation (24) will depend upon the material elevated. If, now, we change the medium instead of the material, the three equations will still remain of the same form, but in addition to the re-determination of a, β and n, the constants in the two last terms of equation (24) will require modification. Thus if the material be water-borne, instead of the figure .0011, a constant must be substituted taken from one of the many investigations upon the flow of water in pipes, such, for instance, as "Hydraulic Flow Reviewed" (Barnes) or the excellent summary in the *Zeitschrift des vereines Deutscher Ingenieure*, 1908, pages 1035 and 1065. The correction to the constant .00092, on the other hand, consists simply in multiplying it by the ratio of the density of the new fluid to that of air; *i.e.*, in the case of water by the ratio $10^6/1230$. In most respects the use of water is more simple than that of air, since the problem of expansion does not arise.

Turning to the modifications in the value of a and β, we can see that the more irregular in form is the material to be conveyed, the more difficult will it be to find a rational basis for a. In the case of grain, notwithstanding the infinite variety in the shapes of individual berries, there is still sufficient constancy—especially in material like North American wheat—to yield a fairly constant relationship between the volume or mass of a berry and its external surface area. Now we must remember that a long symmetrical body in a moving stream of fluid will tend to set itself with its long axis athwart the stream, and we have often observed this to be the case with wheat and barley. We might expect a then to vary directly with the product $d\,l$, where d is the average width or diameter of a particle and l its length; and if we treat the particle as though it were a flat lamina having these dimensions, the force upon it in air would be $2.91 \times 10^{-5}(V_a - V_f)^2$ grammes per square millimetre of its surface; so that $a = 2.91 \times 10^{-5}\,d\,l$. Now from actual measurement of a number of wheat berries in eight tests for the determination of a, Dr. Cramp obtained the following comparison between the rough calculation outlined above and the value of a as measured.

Table VI.—*Actual and Calculated Values of a.*

Experiment.	Aver. $d \times l$. Sq. mm.	a calculated.	a measured.
1, 2, 3 and 4	15	4.365×10^{-4}	4.08×10^{-4}
5 and 6	17	4.94×10^{-4}	4.042×10^{-4}
7 and 8	18	5.24×10^{-4}	4.06×10^{-4}

The comparison shows that the calculated force is of the same order as that given by experiment, which, considering the assumptions, is as much as could be expected. The deduction is that if the medium be varied we should expect a to vary directly with the density of the medium, so that having obtained the value of a experimentally for any one medium, we can deduce it for any other medium; or, if no experiments are available, we could still deduce the probable order of the value of a from the expression

$$a = 2.35\,\Delta\,.\,d\,.\,l\,.\,\times 10^{-8},$$

where Δ is the density of the medium in grammes per cubic metre and d and l are in millimetres. Thus for water $a = .0235\,d\,.\,l\,.$; or, better,

$$\frac{a \text{ for water}}{a \text{ for air}} = \frac{1000}{1.23}.$$

Again, as regards β, we have to remember that the higher the viscosity of the medium the greater will be the loss due to the passage of the medium through the tube, and consequently the lower must the velocity of the medium be for efficient conveying, which indeed is already reflected in the increase of the constant 0.0011. This entails a consequent diminution in V_f upon which β depends (equation 21). But in addition to this, the higher the viscosity of the medium the less tendency is there for the material to travel hither and thither in its passage up the pipe; therefore the less often is it likely to be retarded by striking the pipe walls. This will lead to an intrinsic lowering of the value of β, so that in the absence of determinations such as we have carried out for air we should have no hesitation in taking $\beta = 1$ as a first approximation for a medium such as water.

Adopting these methods of correction, equations (23) and (24) are for the case where water is the conveying medium.

$$V_f = V_a - \sqrt{\frac{W}{a}} \quad \ldots\ldots\ldots\ldots (26)$$

and

$$p_a - p = \frac{L}{F}\left\{2.1\,V_f + 26\,\frac{S}{V_f}\right\} + 0.75\,V_a^2 + 1.72\,\frac{V_a^2\,S}{d} \quad \ldots\ldots (27)$$

where V_a = the velocity of the water in metres per second, and the other symbols have the meaning of Sec. (12). If the material be light compared with water,

* No. III. appeared January 25th.

† These figures are taken for illustration only, and do not represent current practice.

$V_1 = V_0$ approximately, which further simplifies the equation. In any case it will be noticed how much more important are the two last terms in equation (27) as compared with equation (24). Indeed, if the material be very light compared with the medium, it is really raised by displacement, and the pressure $p_0 - p$ is simply that needed to accelerate the medium and to overcome its friction against the pipe, *i.e.*, is simply the two last terms of equation (27). Thus the efficiency of an elevating system in which the ratio of the specific gravity of the medium to that of the material is relatively high, must be small.

Equation (27) is, however, still incomplete if the medium which is being used has a density considerably in excess of that of air, for we found that the power required to lift the volume of the air itself was in any case negligible, and therefore equations (24) and (27), while they cover fluid friction and acceleration, do not include the lifting of a mass of medium. In some cases this may be a very important item, as, for instance, when water is used as the medium, and it will be necessary to add to equation (27) a term which is determined by the height of lift and the specific gravity of the medium. Thus the pressure required in centimetres of mercury to support a column of fluid of height S metres and density Δ is $\frac{100\ S\ \Delta}{13.6}$, and this must be added to equation (27). Since, in the case of water, Δ is unity, the above term becomes 7.32 S.

The above outline is an indication of the manner in which results of a research upon the conveying of grain by air can be utilised to determine the conditions likely to exist when material and medium are changed; but it will be evident that since every material and every medium requires special consideration, not only as regards the form and arrangement of the pipes, but also as regards the type of nozzle to be adopted, the results thus deduced can only be taken to indicate the order of the quantities involved, and experiments similar to those which we have carried out in the one case ought to be tried for every other case before predictions of the power required per ton per hour are indulged in. We feel compelled to lay special stress upon the necessity for careful experimental work, in view of the great importance of the nozzle constant in relation to the design of the plant, as set forth in Sections (14), (15) and (16) above.

(19) Application of the Formulæ to the Problem of Horizontal Conveyors.

All designers of pneumatic elevators have to deal with the problem of conveying material along horizontal and inclined pipes, for it is seldom that an elevator is required to deliver at the immediate end of its lift. The foregoing research work is not directly applicable to horizontal and inclined pipes, which, curiously enough, are theoretically more intricate than simple elevators. Research in this direction is badly needed, and we had in 1920 laid plans for carrying it out, but unfortunately, they had to be abandoned. We did, however, make certain preliminary tests, which, combined with other results obtained by Dr. Cramp independently, give, at any rate, a first approximation for the guidance of the designer. It may be possible to publish these shortly, but in the meantime it is at least worth while remarking upon the idea, prevalent in some quarters, that the power required for horizontal conveying is greater than that needed for elevation through an equal distance. This idea is shown by our experiments to be quite false.

The Costs of a Consulting Engineering Practice.

By A CONSULTING ENGINEER.

In any engineering business, one of the most important considerations is that of the cost of producing whatever machinery or work comprises the speciality to which the activities of the firm are devoted, and this question of costs enters into every department of the business, and influences almost every decision taken.

In most branches of engineering, the determination of such costs is a relatively simple matter. We have, first of all, the raw material, then the cost of skilled and unskilled labour, then the cost of administrative and office staff, and finally establishment charges, such as upkeep of buildings, cost of power, repairs to plant, rent, rates and so forth, all of which can be ascertained without much difficulty, and the true cost of the product be thus arrived at.

In that branch of the engineering profession which is devoted to consulting work, however, the determination of costs is a much more difficult matter. The consulting engineer has no raw material in the ordinary sense of the word, and that which he produces in the shape of reports, designs, professional advice, and so on, cannot be subjected to the processes of analysis in quite the same way as things of a more material nature. Nevertheless, the costs of consulting engineering are a very real thing, and it is the author's object in the present article to endeavour to throw some light on the subject from his own experience during the past few years.

It may be as well to point out that, whatever a consulting engineer's services may be worth, or whatever fees he may charge, it is always a good thing for him to know, as nearly as possible, what the work which he does costs him, and this is especially necessary in work which is charged for on a time basis. There are many cases in which this is done, such as, for instance, in preparing and giving technical evidence, arbitration work, &c. Even in constructional work, where the charge is usually based on a percentage of the cost of the job, it is necessary to provide for charges to be made in the event of the works not being proceeded with, and a knowledge of the cost of time already put in will always be useful in estimating the proper charges in any particular case. The author also has it in mind that many consulting engineers, when first starting, probably have but little reliable information as to the true costs of running a practice, and to such he hopes the particulars now given may be of use.

In setting up a practice, the first consideration is to secure a good office in a suitable locality. The size of the office and the number of rooms depend, of course, on the engineer's idea as to his prospects of success; but in the author's opinion, it is wisest, at any rate, to start with, to be content with one moderate sized room in a good situation. Such a room should be well lighted and airy, as it is very trying to do work such as making drawings and calculations in a badly ventilated or ill-lighted office.

The next item is that of furnishing, and here, again, individual tastes and ideas will affect the cost to a certain extent. In general, however, it should be borne in mind that a considerable proportion of the engineer's time will be spent in his office, and it is, therefore, of importance that it should be well and tastefully furnished, and this is not only advisable, in regard to the engineer's personal comfort, but it is also necessary from the point of view of business.

The author gives below particulars of the expenditure incurred by him in furnishing and setting up his first office, which consisted of one room about 16ft. by 12ft. The office was completely repainted and redecorated by the landlords, free of charge, on the author's taking up the lease, so that he was not put to any expense under that head.

The author did without a typewriter at first, and had any typing he wanted done by a bureau, but afterwards he was fortunate enough to have one presented to him. The cost of a good standard typewriter at the present time may be taken as £25. The cost of instruments, if such are required, will depend on what the engineer already possesses, and on what particular branch of engineering is to be taken up, and such cost must, of course, be added to that of furnishing in order to arrive at the capital outlay involved.

Expense of Furnishing an Office:—

	£	s.	d.
Wilton carpet and felt	17	16	0
Curtains, brackets and rod	1	10	4
Kerb for hearth, coal scuttle and hearth-brush	4	1	3
Mahogany pedestal desk	24	0	0
Armchair in polished oak, upholstered in leather	5	0	0
Two office chairs	8	15	9
Inkstand, two letter baskets, waste-paper basket, and calendar	1	15	6
Typist's desk	6	0	0
Adjustable drawing board trestle	5	0	9
Oak stool for drawing board trestle	2	5	0
Double elephant drawing board	2	6	4
Tee-square and three set-squares	1	2	0
66ft. steel measuring tape	1	7	10
Ivory 2ft. rule	2	3	11
Drawing paper, tracing cloth and other drawing-office materials	3	0	7
Dies for notepaper and plate for visiting cards	2	6	0
Notepaper and stationery	4	10	9
Kempe's Engineer's Year-book	1	5	0
100 lb. spring balance for testing purposes	1	12	6
Sundries	1	9	2
Writing name on door and in entrance hall of building	1	6	6
Office fixtures, &c., viz.:—Putting up two shelves, alterations to electric lighting, fixing gas meter and ring	5	6	6
Total	104	9	5

The next question is that of the cost of keeping up the office, and of the hundred and one every-day expenses which are inseparable from any consulting practice. The author has kept a most careful record of all his expenses, and has carefully analysed them under the headings of office rent, cleaning, fuel, and lighting; telephone; stationery, blue prints, &c.; postage and telegrams; travelling expenses; salaries and typing; and sundries; and he has constructed a diagram showing graphically and to scale, the actual amounts spent by him under each heading during the four years 1919, 1920, 1921 and 1922, with the exceptions that the outlay on his original stock of stationery and drawing-office materials is not included, as they are comprised in the capital outlay given above, and that items, such as cablegrams and travelling expenses, for which he was, naturally, reimbursed by his clients, have also been omitted.

The diagram is given in Fig. 1, and will show at a glance the amounts under each heading, and also the total amount per annum, of all the items added

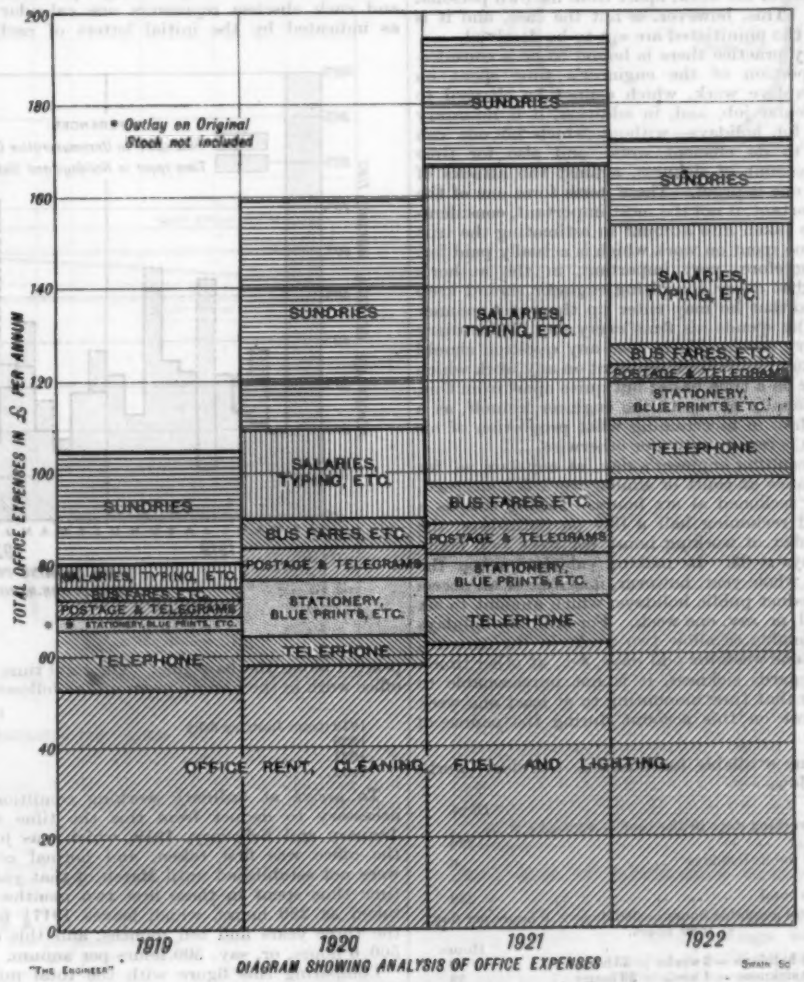


FIG. 1

together, and the proportion which each item bears to the total.

A few words of explanation are perhaps necessary with regard to one or two points. It will be noticed that the cost of the telephone was much greater in 1919 than in the following year. This was because when it was put in a surcharge of £4 was made to cover the cost of installation. This practice, however, was discontinued when the telephone rentals were raised by the Post Office authorities in 1921. The large addition to the cost of rent, &c., in 1922 was due to the increase of rent on the expiration of the first lease, which was a very general experience at that time. A further expense which should be allowed for, though not shown in the diagram, is that of depreciation on the original cost of office furniture and equipment, and a fair allowance is 15 per cent. per annum. This is quite a considerable item, and it takes a good many years to write off £100 at this rate.

The cost of salaries depends, of course, on the amount and kind of assistance which the engineer requires. Apart from technical staff, he will probably find that a lady secretary is about the most valuable kind of assistant to employ, and that she can save his time in many ways in addition to her ordinary duties of correspondence, book-keeping, &c. In estimating the cost of assistants' time, allowance must be made for additional expenses due to increased office accommodation, fuel, lighting, &c., and for the proportion of the consulting engineer's own time which is taken up in supervising their work.

Having dealt with the matter of office expenses, it may perhaps be imagined that this is all that has to be taken into account by the engineer in estimating the cost of his work, apart from his own personal expenses. This, however, is not the case, and it is here that the uninitiated are apt to be deceived.

In every practice there is bound to be a considerable proportion of the engineer's time spent on unremunerative work, which cannot be charged to any particular job, and, in addition, it is necessary to allow for holidays—without which no one can continue to do efficient work—and also for time lost on account of sickness, against the attacks of which no one is proof. These items form one of the most important, if not the most important, consideration to be taken into account in estimating the true cost of time spent on work which is actually paid for. It, is, therefore, very important, in the author's opinion, that every consulting engineer should keep a diary, so that he may enter up the exact manner in which he spends his time every day. This diary is also very serviceable in case any question should ever be raised as to the time spent on any work which is paid for on a time basis; but quite apart from this, it is principally of use to the engineer himself, as a guide to him in ascertaining what proportion of his total time is remunerative or otherwise.

The consulting engineer's day, at any rate as far as attendance at court or similar work is concerned, is usually reckoned at six hours. Taking this as a basis, and reckoning half a day on Saturdays, the total number of working hours per week = 6 hours by 5½ days = 33. In making calculations on the basis of a whole year, however, it is first of all necessary to deduct public holidays, which amount to six days in all, or, say, one week. For ordinary holidays it is reasonable to allow two weeks in the summer, and, say, one week for odd days, &c., at other times, and as regards sickness, it is not unreasonable to anticipate that time amounting to at least one week will be lost on this account during the course of the year.

The time available for business, therefore, works out as follows:—

	Days.
Total working days in the year = 52 weeks × 5½ days	= 286
Deduct public holidays	6
∴ Net total	= 280

∴ Total available hours = 280 days × 6 hours per day = 1680 hours.

	Hours
Deduct holidays = 3 weeks × 33 hours	99
Deduct sickness = 1 week × 33 hours	= 33
∴ Total holidays and sickness	132

The proportion of the total available working time taken up by holidays and sickness on this basis is, therefore $= \frac{132}{1680} \times 100 = 7.9$ per cent., or, say, 8 per cent.

Many consulting engineers no doubt work considerably more than the six hours a day, taken as a basis for the above calculations, but that fact does not affect the proportions arrived at, as the allowance for the total number of hours spent in holidays or sickness would be correspondingly increased.

In the author's own case, the average number of hours actually worked, plus actual time taken up by holidays and sickness, allowed for at the rate of 35 hours a week, amounted to an average of 2091 for each of the four years 1919 to 1922 inclusive, which, taking 51 weeks' available working time in the year, averages about 41 hours a week, and the proportion of the time spent in holidays and sickness, exclusive of public holidays, was as follows:—

	Per cent.
1919	6
1920	8.95
1921	10.35
1922	6.35

The average for each year, therefore, works out at 7.91 per cent. which agrees almost exactly with the approximate estimate given above. The author has perhaps taken somewhat more than the amount of holiday allowed for in the estimate, but has, on the whole, lost rather less than the estimated time from sickness.

The next consideration is that of time spent on necessary but unremunerative work, which the author designates by the general term of "office work." Such work can, of course, be reduced to some extent by the employment of a secretary; but she can only relieve the engineer of a certain proportion, and there always remains a large amount which the engineer must do himself, such as interviews, correspondence, and the thousand and one other matters which claim his personal attention. The author can only speak for himself in this matter; but he has no reason to think that his experience differs very materially from that of other consulting engineers. He has had his daily diary carefully analysed, and has taken out the exact time spent each month in "office" work as described above for the four years 1919, 1920, 1921 and 1922, and has worked out the proportion which such time bears to the total available time in each month, and also the proportion taken up by holidays and sickness, and the results are shown graphically in the diagram given in Fig. 2.

In this diagram the ordinates represent percentages, the total height being equivalent to 100, and each abscissa represents one calendar month, as indicated by the initial letters of each month printed along the base line. The total time spent in office work in the various years was as follows:—

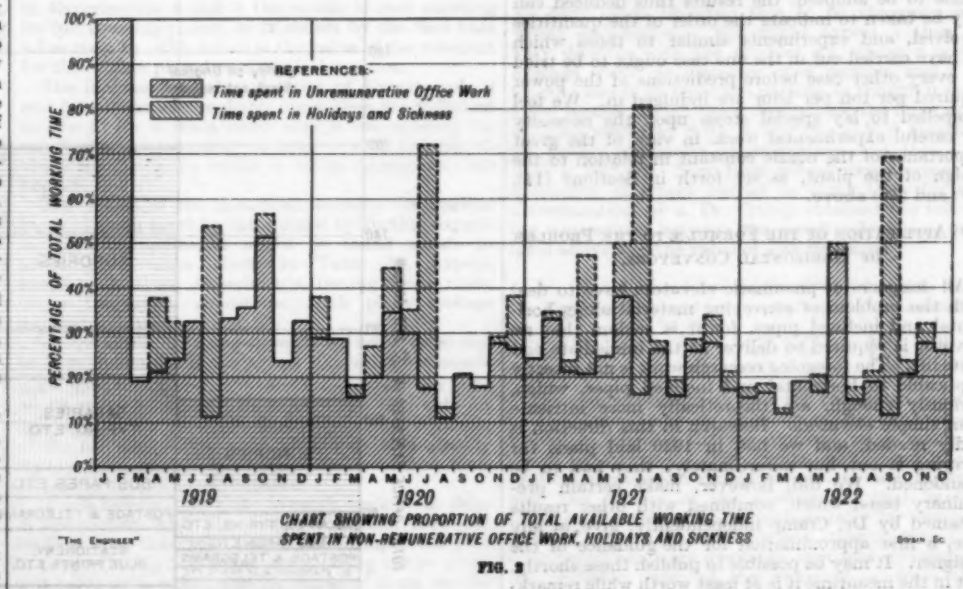

REFERENCES:-
Time spent in Unremunerative Office Work
Time spent in Holidays and Sickness
PERCENTAGE OF TOTAL WORKING TIME
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1919
1920
1921
1922
"The Engineer"

CHART SHOWING PROPORTION OF TOTAL AVAILABLE WORKING TIME SPENT IN NON-REMUNERATIVE OFFICE WORK, HOLIDAYS AND SICKNESS

FIG. 2

	Hours.
1919 (from January 6th)	772½
1920	474½
1921	525½
1922	424½

To arrive at ordinary working conditions, it is necessary to deduct from this the time spent in January and February, 1919, which was just after the office was first taken, and normal conditions were not established until March of that year. The time thus spent in these first two months may be taken as 280 hours, which leaves 1917½ hours for the three years and ten months, and this averages 500.6 hours, or, say, 500 hours per annum.

Comparing this figure with the total number of hours actually worked, plus holidays and sickness as given above, viz., an average for the four years of 2091 available hours in each year, the proportion spent in office work is $\frac{500}{2091} \times 100 = 23.9$ per cent.

Adding to this figure the proportion due to holidays and sickness, viz., 7.91 per cent, we get altogether 31.81 per cent., or, say, 32 per cent. of the total time available, which was spent in non-remunerative office work, necessary holidays and sickness. We have, therefore, only 68 per cent., or, say, but two-thirds of the total, as the average proportion of time which can be devoted to actual remunerative work under average conditions. This forms a very important factor in the cost of work, as it constitutes in reality an overhead charge of something like 50 per cent. Thus, for every hour which a consulting engineer puts in on any particular job or case, he has to reckon that actually about 1½ hours of his available time will have gone to the production of the one hour's effective work.

There remains to be taken into account the engineer's own personal expenditure or cost of living, and, as to this, the author says nothing, as every case will naturally vary according to the individual concerned.

To sum up, the conclusion which the author has arrived at may be stated as follows:—

The true cost to a consulting engineer of the services which he renders, consists not only of his personal expenditure plus his office expenses, staff, &c., but also of an overhead charge amounting to some 50 per cent. in terms of hours, due to the time necessarily consumed in non-remunerative directions, and, therefore, in order to obtain the cost per hour of actual paid work, the total monetary cost per annum must be divided by the number of hours actually spent on such work, which amounts on the average to only about two-thirds of the total number of hours available. Stated as a formula this is

$$\text{True cost per hour of remunerative work} = \frac{\text{Personal expenditure per annum + office expenses, \&c., per annum}}{\text{Total available hours} \times 0.66}$$

It should be remembered that these notes have not been compiled with a view to laying down in any way what charges should be made by a consulting engineer, as such charges depend not simply on cost, but also on a variety of other circumstances; but the author hopes that at least they may indicate how the making of inadequate charges may be avoided.

In many instances the value of a consulting engineer's services to his client may be out of all proportion to the actual present cost of rendering them by virtue of the special knowledge which he possesses, but which may have taken him years of patient study to acquire, and the actual monetary cost is, therefore, in many cases no criterion of the charge which should be made.

The author has recognised from his own experience the importance of having an accurate knowledge of the costs of his practice, and trusts that the results which he has here set down may be serviceable not only to consulting engineers, but perhaps also to others interested, who may not have given the subject the consideration which it should undoubtedly receive.

Electric Industrial Heating.

By HAMLYN M. DRAKE.

ALL manufactured articles must eventually stand on their merits, and England has always in the past led the way with improvements. Now, however, America has gone ahead of us in many trades owing partly to her natural resources and partly to enterprise; and if we are to keep pace with her we must avail ourselves of her experience without delay. She has made notable advance in work requiring accurate temperature control of furnaces in such operations as the heat treatment of steel, the annealing of glass, both for high-grade lenses and commercial glass bottles, the vitreous enamelling of steel hollow-ware and cast iron baths, the enamelling and japanning of motor car wings and bodies, and, in fact, all the operations requiring temperatures not exceeding 1000 deg. Cent. For such duties electricity has proved to be an admirable medium. There are two main reasons for the high quality of the product of the electric furnace. (1) Accurate temperature control where a steady temperature is required. In the annealing of glass where a known time-temperature curve must be followed, a control of within 5 deg. Cent. ± can be obtained. (2) The transmission of heat by radiation and not by convection

currents. The penetrating quality of radiant heat is well known and results in a very even distribution of temperature throughout the furnace. The heating units are seldom more than 75 deg. Cent. above the temperature of the work, and consequently there is no danger of "burning," and scaling is materially reduced owing largely to the inert atmosphere in the furnace. In wire annealing it is usually possible to dispense with the metal pots altogether, and even when that course is not possible, the life of the pots is considerably lengthened.

Were these advantages the only considerations, electric heating would be universal; but, unfortunately, the cost of current in England has to be considered, and it must be admitted that the prevalence of the electric furnace in America is in part due to the fact that, there, cheap power is more frequently available than in this country. From the power-house point of view electric furnaces should be encouraged as much as possible, for they operate at unity power factor and in most cases the load factor is very high. Even at present prices, however, electric heating can usually hold its own if a true comparison is made with other means of heating. Such a comparison must include all the incidental expenses of heating, such as, maintenance of furnaces; coal, coke or oil storage; necessary haulage; sidings; cranes and handling gear for fuel and ashes; labour and the losses due to "wasters." As an instance of a fair comparison, the writer saw an electric glass annealing lehr in California, of which the running expenses compared favourably with those of an oil-fired lehr of the same capacity, the oil costing 2 cents per gallon and the average price of current in that district being approximately 1 cent. per unit. The demand for electrically-annealed bottles was so large that purchasers expressed their willingness to pay 25 per cent. more to insure a supply of bottles annealed electrically, because they found that breakages during corking, &c., were so greatly reduced, that it paid them to buy the better bottles at the higher price.

In a paper which was read before the American Ceramic Society, Mr. E. F. Collins gives some very interesting information with regard to the annealing of glass, and Curve No. 1—Fig. 1—shows the time temperature curves with three different degrees of accuracy of control. It is seen that with a temperature variation of 5 deg. Cent. ±, which is easily obtained with automatic electric control, the annealing time required is 60 per cent. less than when the temperature variation is 15 deg. Cent. ±. Fig. 2 shows the temperature distribution in a circular furnace when the temperature is being raised at varying rates, and it is interesting to note how closely the reading from the five thermo-couples, whose positions are indicated on the drawing, agree. It is this even distribution, in conjunction with the accurate control, which renders electric heating ideal for annealing lenses of all sizes, for a badly annealed or broken lens may render useless the work of many weeks.

During the war four large vertical furnaces were installed in America for the heat treatment of gun forgings, and a very complete set of tests was run on this installation, the results of which are given in Table I.

TABLE I.

Heating to 780 deg. Cent. Furnaces hot when charged. Furnaces 6ft. diameter by 24ft. high. Voltage 440, three-phase, 60 cycle, each furnace rated at 400 kilowatts.

Charge.	Total weight, including holding fixtures. lb.	Energys in K.W. hours.
Twelve 3in. gun tubes	21,900	1874
Seven 4in. gun tubes	22,300	1880
Three 4in. jackets	21,700	2088
Total	65,900	5842

Average pound per K.W. hour = $\frac{65,900}{5,842}$ = 11.25.

K.W. hour per short ton = 178.

Energy cost per ton at .85 cents per K.W. hour = 1.52 dols.

This table shows what can be done with the electric furnace in operations of a moderate size. The time required to reach the desired temperature was 5½ to 6 hours, and the radiation loss proved to be 70 kilowatts, the calculated figure being 75 kilowatts. Actual operating results for the four furnaces for October, 1918, when production was at the maximum rate, including hardening at 780 deg. Cent., and drawing at 625 deg. Cent., showed a cost of 2.76 dols. per ton based on a power cost of .85 cents per kilowatt-hour.

In a vitreous enamelling oven used for making special enamelled resisters, where the enamel was applied over wire wound on porcelain tubes, the "wasters" were reduced from 25 per cent. practically to nil, and the costs were carefully tabulated on certain tests runs. The furnace consisted of two chambers, each 4ft. by 18in. by 24in. high, with a temperature of 300 deg. Cent. in one chamber and 900 deg. Cent. in the other. The results obtained were as follows:—

Hours run	1.33
K.W. hours consumed	43.8
Fired nine loads of thirty-five 6½in. tubes	—
Weight of thirty-five tubes	9 lb.
Weight of rack	13.5 lb.
K.W. hour per pound of tubes	.541
K.W. hour per pound of tubes and racks	.266
Cost of current	1.25 cent per K.W. hour
Cost per pound of tubes	.676 cent
Cost per hour	.41 dols.

With the oil furnace which the electric furnace replaced, the oil consumption was 6 gallons per hour, and the price of oil at the time was 13 cents per gallon, making the running costs .78 dollars per hour.

The same furnace was also used for enamelling small push buttons, with the following results:—

Hours run	4
K.W. hours consumed	97.3
Fired eleven loads of push buttons, forty-eight pieces per load	—
Total weight of push buttons	52 lb.
Total weight of eleven racks	121 lb.
K.W. hour per pound of load	.562
K.W. hour per pound of push buttons	1.87
Cost per pound of push buttons	2.338 cents
Cost per hour	.3 dols.

A series of tests was carried out on ovens requiring a lower temperature, such as those suitable for core baking, japanning, &c., and the Table II. gives representative results, two instances being given from tests on four separate ovens, each used for core drying and each having internal dimensions of 5ft. by 10ft. by 7ft. The difference in the readings is due to the varying sizes of the cores baked, the largest weighing 124 lb. and the smallest 1¾ lb.

TABLE II.

Time entering oven.	Time switch was thrown.	Time withdrawn from oven.	Bak'g period.	K.W. hours used.	W'ght of cores.	No. of cores	Lb. of green cores baked per K.W. hour.
A			h. m.		lb.		
8.50	2.05	2.05	5 15	224	2635	43	11.8
2.00	5.05	5.05	3 5	116	1899	719	16.4
B							
1.45	5.15	5.15	3 30	144	1774	396	12.3
11.40	2.50	2.50	3 10	160	1302	350	8.2
C							
8.35	1.15	4.00	7 25	236	2284	43	9.7
1.45	5.00	5.20	3 35	136	2408	303	17.6
D							
8.10	1.30	1.30	5 20	248	2542	45	10.2
1.45	5.50	6.20	4 35	176	1957	37	11.1

The aggregate of forty-nine tests on the four ovens showed 108,730 lb. of green core baked with 9389 kilowatt-hours, giving an average of 11.6 lb. per killowatt-hour.

Other instances can be cited in connection with other trades. For instance, the case of a large annealing furnace for small castings where two men are now doing the work of eight owing to automatic temperature control and the saving in stoking, and cartage of fuel and ashes, &c., labour being required only to load and unload the furnace.

The maintenance on an electric furnace is low, as the firebrick has only to stand temperatures of 1050 deg. Cent. as a maximum, and the metallic resisters, which are made of a special nickel chromium alloy appear to last indefinitely; at any rate, exhaustive physical and chemical tests show no alteration in the elements after two years continuous operation at 1000 deg. Cent. The simple rugged construction which needs no ports, flues, dampers, arches, &c., inherent in the design of fuel-fired furnaces, also tends to low maintenance costs.

High thermal efficiency is always obtained, for heat insulation is a simple matter when the furnace proper consists essentially of a firebrick box with the heating units hung on the walls, and the losses in the chimney and flues are naturally non-existent. Fig. 3 shows the relative thermal efficiencies of electricity and pure carbon as a fuel at all temperatures up to 2000 deg. Cent. In both cases the radiation losses have been assumed to be the same, though in practice the electrically-heated furnace would undoubtedly

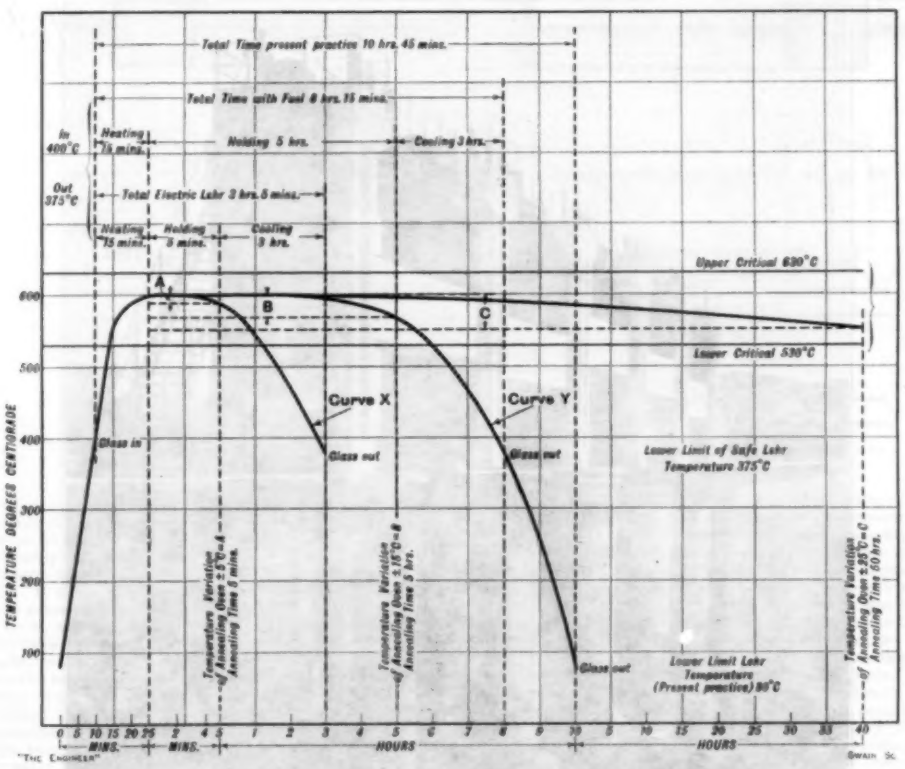
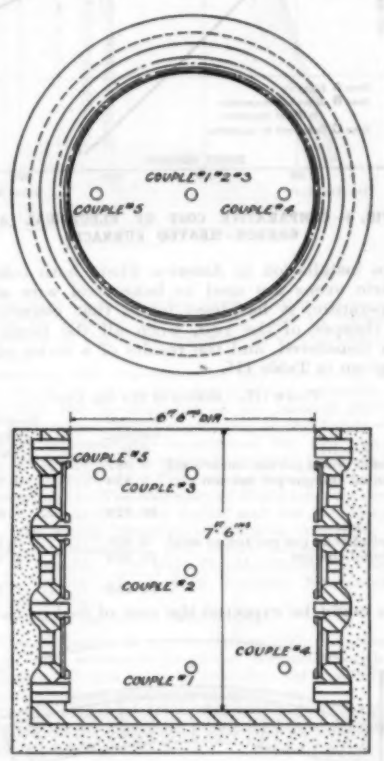


FIG. 1—CURVES RELATING TO THE ANNEALING OF GLASS



TIME	THERMOCOUPLES-TEMP °C					AVER.	VARIATIONS FROM AVERAGE		RATE OF CHANGE
	1	2	3	4	5	TEMP.	ABOVE	BELOW	DEG PER HR
11.30	25	25	25	25	25	25	0	0	
5.30	527	537	532	530	545	534	2·07	1·31	127°C
7.30	670	679	671	666	669	669	1·5	·45	34
11.30	777	785	776	766	780	776	1·0	1·3	27
3.30	858	864	857	849	864	860	·46	1·3	21
7.30	860	865	862	862	863	862	·35	·23	0
11.30	928	934	930	930	928	930	·43	·21	17
3.30	933	932	927	925	927	929	·64	·43	0
4.30	950	950	952	952	955	952	·31	·21	23

"THE ENGINEER" SWAIN Sc.

FIG. 2—DATA OF TEMPERATURE DISTRIBUTION

be more efficient in this respect. Carbon has been chosen as representative of all the fuels normally used, for the sake of simplicity. In actual fact the curves for coke, coal, gas and oil very nearly coincide with that shown. Calculations are based on 50 per cent. excess air, and curve C shows efficiencies when no recuperation is arranged. Curve B is based on the assumption that the outgoing gases are at a temperature of 30 per cent. of the operating temperature of the furnace. To obtain this result it is necessary with fuel-fired furnaces to install costly recuperative arrangements which occupy considerable space. Even when this is done the simple construction of the electric furnace still shows a higher efficiency. From a study of the curve it might be expected that at a temperature of 275 deg. Cent. the increase in efficiency of electrical heating would not be sufficient to warrant its adoption; but

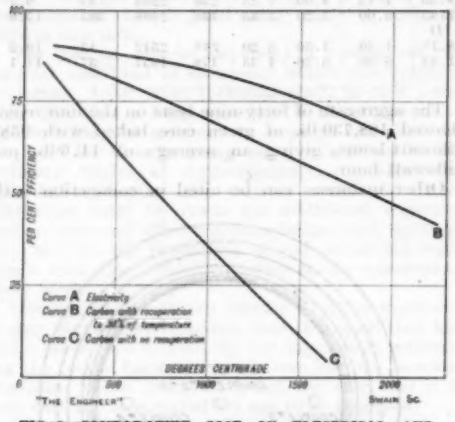


FIG. 3—COMPARATIVE COST OF ELECTRICAL AND CARBON-HEATED FURNACES

in an installation in America where both coke and electric ovens are used to bake steel wire at this temperature, it has been found that electricity is the cheaper of the two, when all the items have been considered, and the results of a series of tests are given in Table III.

TABLE III.—*Baking at 275 deg. Cent.*

	Normal output. dols.	Maximum output. dols.
Electric—		
Cost of power per net ton of steel	5.087	1.19
Annual charges per net ton	7.839	0.727
	12.926	1.917
Coke—		
Cost of coke per net ton of steel	0.921	0.171
Annual charges	21.368	1.983
	22.289	2.154

As might be expected the cost of fuel in the coke

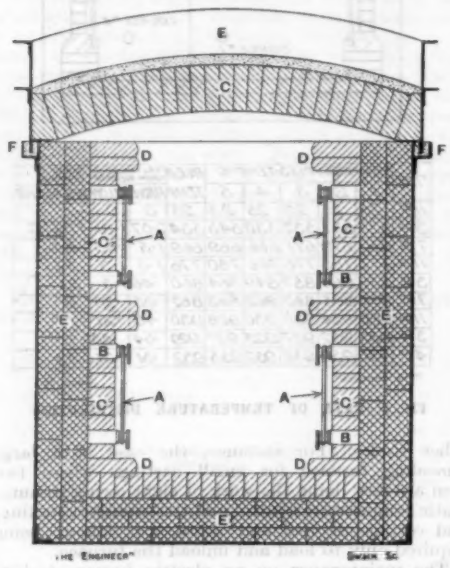


FIG. 4—ELECTRIC FURNACE FOR HEAT TREATMENT

furnace is negligible in comparison with the charges for maintenance, handling, &c., whereas, in the case of electricity, the expense is about equally divided between the energy costs and running expenses.

Fig. 4 is a drawing showing the general design of a pit furnace suitable for the heat treatment of shell cases, gears, guns, &c. A are the heating units, B the hanger blocks, C is firebrick, and E insulating brick, while F is a sand seal. Other classes of furnace embody this general design as a basis, with modifications to suit the individual conditions, the types mostly used being:—

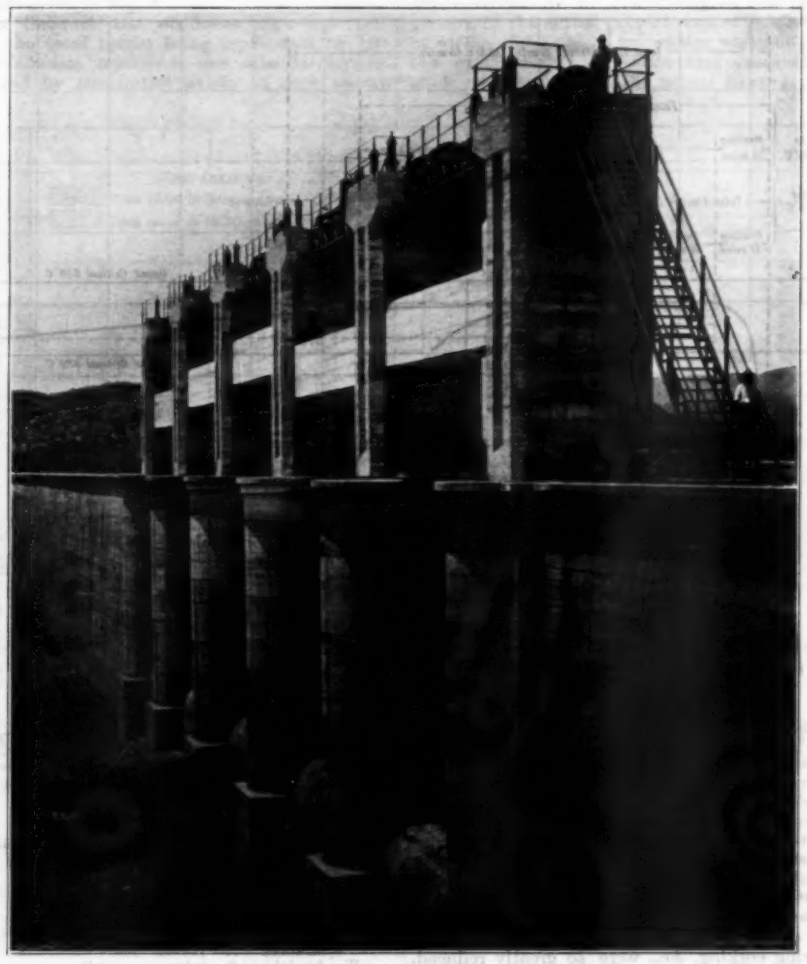
(1) Simple box-type with one door.
(2) Tunnel type with two doors.
(3) Truck type with one or two doors.
(4) Rotary type.
(5) Conveyor type.
(6) Recuperative type, in which the hot outgoing work gives up much of its heat to the cold incoming work, thereby pre-heating the latter.

There are other advantages to be considered, such as cleanliness and comfortable working conditions, and it has usually been found that in electric furnaces a lower temperature or a shorter time cycle or both give better results than can be obtained by old-fashioned methods. It will be seen that the price of current, although important, is not always the determining factor, and the general adoption of electric heating will materially help to bring down the price per unit, as overhead charges necessarily form a smaller percentage of total cost when large loads at unity power factor are available.

Finally, the writer is convinced that the improved quality of material alone will make it essential for the future of British trade that electricity should be used extensively for industrial heating, and supply companies will find it to their advantage to encourage this peculiarly attractive type of load by offering special rates for energy.

The Lake Mentz Dam on Sundays River.

ONE of the most interesting of the recent impounding schemes is that of the Lake Mentz dam, which has been carried out by the Sundays River Irrigation Board on the Sundays River, about 90 miles north of Port Elizabeth,



THE LAKE MENTZ DAM, SHOWING THE SLUICES

South Africa, the steel flood-gate work of which was supplied by Glenfield and Kennedy, Limited, of Kilmarnock.

Essentially, the dam, which is illustrated herewith and in the engraving on page 122, consists of a massive ferro-concrete structure, at one end of which are five bays with substantial piers, between which are suspended five free roller steel sluice gates, each 30ft. wide by 25ft. deep. The piers are of reinforced concrete, and reach down to bedrock in common with the dam wall with which they are in line. A further interesting feature of this important work consists in the employment of reinforced concrete for the construction of the main columns which carry the steel superstructure and operating gear for the gates, and from which the gates themselves are suspended. In addition, the counterbalance weights for the sluices are built of concrete, reinforced throughout, this method providing an exceedingly strong, and, we understand, a relatively economical job.

The sluice gates themselves are of the free roller type in accordance with Glenfield and Kennedy's patented improvements, the weight of each gate being about 25½ tons, while the counterbalance weight is 53 tons, the whole being designed for a water pressure of 26ft. head.

Each gate is built up of latticed bow-string girders spanning the opening, the latticed girders being riveted and strongly plated to the vertical end posts of the gate. These end posts are built up of rolled steel joists, and plates, &c., and are machined parallel and on the same plane to receive and carry the rocking paths for the rollers. On the up-stream side of the gates ⅜in plating, arranged in panels, is riveted to the girders, with horizontal butt straps, the horizontal latticed girders being braced together vertically by angles and plates at intermediate points in the length, whilst the adjustable plate on the bottom edge of the gate is in lengths and machined on the contact edge. The roller paths for the gates, which are of mild steel, are also machined on all their contact surfaces, the fixed portion of the path being riveted to the gate and posts, while the rocking portions of the path are attached to the fixed path by bronze swivel pins at the bottom, top and centre.

To allow for any possible deflection in the gates and inaccuracies in the construction of the masonry, and in the fixing of the cast iron grooves, the rocking paths are made with a curved projection, which permits the roller path to adjust itself to the rollers by rocking with the rolling motion. The free rollers on which the gates travel when in position are of hard cast iron, and are made truly cylindrical. They are contained in a mild steel cage, which has channel iron sides with stout fixed pins through the centre of the rollers, the holes in the rollers being bushed. The whole cage containing the rollers is compelled to travel in the cast iron groove by means of clips which work in recesses on the sides of the path.

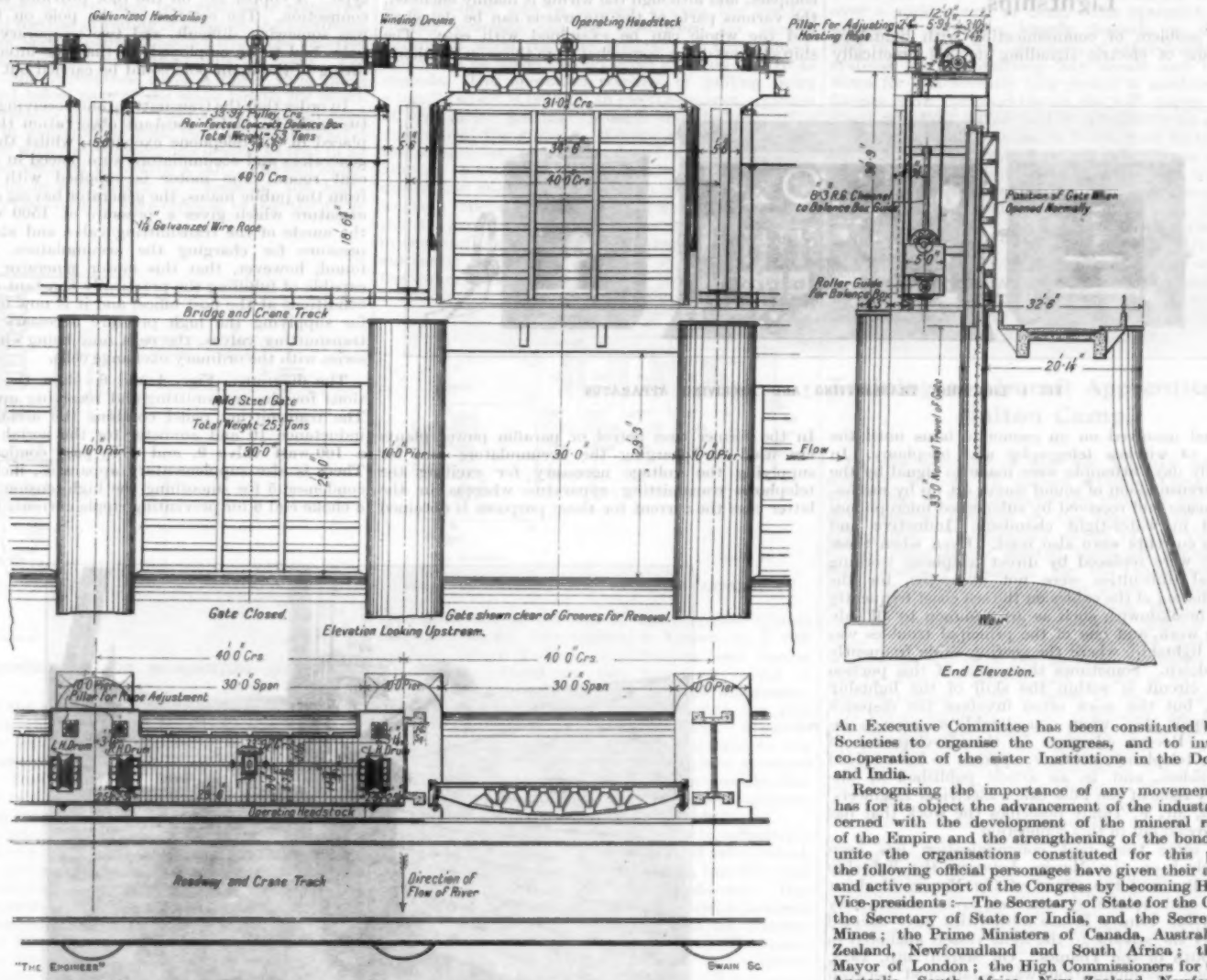
The cage hangs in the bight of the suspension rope, one end being attached to the gate and the other end to the top of the cast iron groove. Its travel, therefore, corresponds to half the travel of the gate. The staunching bars for the gate side joints are of the solid drawn type. They are machined on the external surface, and are loosely suspended from the gate by chains, so that they are sensitive to water pressure when the gate is closed, and bear on the machined faces which are attached to the gate and the groove respectively. The grooves themselves are of cast iron. They extend from the floor to the top of the masonry piers, and are erected in lengths and machined where any two surfaces come together, all the joints being provided with fitted bolts, and the lower portions of the side groove being fitted with gun-metal faces for the staunching bars.

The pulleys for the counterweight ropes are of cast iron, machined for the rope, and are furnished with long roller bearings. The guides for the counterbalance weights consist of channels, which are attached by binding bolts to the superstructure. The two hoisting ropes for the gates are of galvanised steel, and have a nut breaking stress of about 66 tons each. The suspending shackles are adjustable, so that they can be set towards the back or the front to ensure the gate hanging vertical. The ropes have spliced-in solid eyes at each end, and are provided with the necessary adjusting screws, which are of sufficient length to take up the "stretch" and to lower the balance weight on to the piers when it is desired to remove a gate from its groove for repairs.

The gearing is of the rapid lifting conical drum type, the winding drums being of cast iron, with helical grooves machined in them for housing the hoisting ropes. Its main

SLUICE GATES OF THE LAKE MENTZ DAM

GLENFIELD AND KENNEDY, LIMITED, KILMARNOCK, ENGINEERS



bearings are equipped with self-aligning roller bearings specially designed so as to permit of as much freedom as possible in working, and each runs in an oil bath carried in a dust-proof case. This gearing has both spur and worm reduction arranged in a dust-proof headstock and running in oil. It is operated by double crank handles. To permit of the gates being rapidly raised to cope with an approaching flood, each gate is provided with a trip clutch, which, when released by hand, permits the heavy counterbalance weight, which, as will have been noticed, is just over twice the weight of the gate, to descend, thus automatically raising the gate. The speed of falling of the gate is governed by a special time control gear, which works in conjunction with the helical grooves on the drums, the latter being so arranged that the diameter at the edges is greater than at centre of the drum, so that, in consequence, the gate is automatically retarded as it approaches the end of its travel, and is finally brought to rest when the limit of travel is reached. By this arrangement, any shock or jar on the completion of the travel is, it is claimed, entirely eliminated.

The whole arrangement is designed to give two lifting speeds :—

(1) Rapid automatic, both when lifting and closing, which is obtained by withdrawing the free roller clutch by means of the handle on the headstock.

(2) Slow speed by hand through the ordinary crank handles.

The gates can be locked in any position of their travel —when the clutch is engaged—by means of a pawl. A tight joint at the bottom edge of the gate is obtained by means of an adjustable steel bar, which is machined on the edge. When the gate is lowered, this bar rests finally on a hard wood beam bolted to a cast iron sill, which is firmly secured to the masonry floor, but which can be readily renewed as required without disturbing the main structure.

To facilitate the erection of these large gates at the site, Messrs. Glenfield and Kennedy's contract included the supplying of a specially designed travelling gantry, arranged to run on a rail track laid alongside the barrage on the pier tops, and having the form of a carriage to support each gate during transit. In addition to the longitudinal travelling motion, small carriages are arranged to travel on the main structure of the crane in a transverse direction, so that each gate can be loaded or unloaded from the crane at any desired bay in the barrage or hauled to the bank, as desired.

Among the features of the complete design, to which the makers draw special attention, is, in the first place, that the gates and all the accessories are constructed throughout to give maximum degree of water-tightness with a minimum of friction in working. The free roller design of gate is, it is pointed out, absolutely essential for conditions such as are met in the case of the Sundays River dam, and it is characterised by the fact that, when the sluice gate is raised clear of the water, the staunching tubes and rocking paths are also lifted clear with it, and can be readily examined or repaired. Furthermore, the roller trains are so constructed that repair is a comparatively simple matter. Great attention has, because of the exposed nature of the work, also been paid to the question of lubrication. All the bearings intended to relieve friction are provided with rollers or balls, and all the gears are continuously submerged in oil, while all working bearings are housed in dustproof cases, the result being, so it is stated, that the weight immediately responds to manual power, even when applied after very long intervals. The "quick-lifting" arrangement is described as being particularly effective, as it enables the attendant rapidly to open one or all of the sluices in event of heavy floods coming down the river, while the degree of opening of each sluice can be perfectly controlled at the operating geared headstocks, as, for example, when scouring out.

Altogether, the installation affords an excellent example of British workmanship in a difficult field of engineering.

We may add that the dam itself was designed by the Sundays River Irrigation Department, Mr. F. E. Kanthack, M. Inst. C.E., being then Director of Irrigation, and that it was constructed departmentally by the Irrigation Board under the direction of Mr. R. W. Newman, M. Inst. C.E., Resident Engineer, who had Mr. A. S. Bridgman as his assistant engineer.

Empire Mining and Metallurgical Congress.

As a result of discussions between the Councils of the following bodies, it has been decided, as previously announced, to convene an Empire Mining and Metallurgical Congress to be held in London on June 3rd, 4th, 5th and 6th next, in connection with the British Empire Exhibition :—

The Institution of Mining and Metallurgy (mining of minerals other than coal and production of metals other than iron and steel),
The Institution of Mining Engineers (coal-mining engineering),
The Institution of Petroleum Technologists,
The Iron and Steel Institute,
The Institute of Metals,

representing the scientific and technical interests of the mineral and metal industries, with

The Mining Association of Great Britain, and
The National Federation of Iron and Steel Manufacturers,

representing the colliery proprietors and iron and steel manufacturers respectively, of the United Kingdom.

An Executive Committee has been constituted by these Societies to organise the Congress, and to invite the co-operation of the sister Institutions in the Dominions and India.

Recognising the importance of any movement which has for its object the advancement of the industries concerned with the development of the mineral resources of the Empire and the strengthening of the bonds which unite the organisations constituted for this purpose, the following official personages have given their approval and active support of the Congress by becoming Honorary Vice-presidents :—The Secretary of State for the Colonies, the Secretary of State for India, and the Secretary for Mines ; the Prime Ministers of Canada, Australia, New Zealand, Newfoundland and South Africa ; the Lord Mayor of London ; the High Commissioners for Canada, Australia, South Africa, New Zealand, Newfoundland and British India.

The Congress has for its chief objects :

(*a*) The discussion of papers dealing with the scientific, technical and economic problems connected with the development of the mineral resources of the Empire, and the mining and metallurgical industries.

(*b*) The constitution of an Empire Council of Mining and Metallurgical Engineering Institutions, the principal functions of which would be :

(1) To serve as an organ of intercommunication between the co-operating institutions, and to promote the interests of the professions and industries ;

(2) To create and maintain throughout the Empire a high standard of technical efficiency and professional status ;

(3) To convene successive Congresses within the Empire ; and

(4) To establish, if it be found after discussion by the Empire Council and the co-operating institutions to be necessary or desirable, a Register of British Mining and Metallurgical Engineers.

The Viscount Long of Wraxall, President, will preside over the main sessions and at the official banquet, which it is hoped will be held, by the courtesy of the Corporation of the City of London, at the Guildhall. The President will deliver as his address from the chair "The Sir Julius Wernher Memorial Lecture," and he will take as his subject "Mineral Resources and their Relation to the Prosperity and Development of the Empire." The papers accepted for discussion—a list of which will be issued later—will then be presented and remitted for discussion by the appropriate sections, which will meet in the conference halls allocated to them, morning and afternoon, on Wednesday, June 4th, and Thursday, June 5th, for the reading and discussion of papers. In the evening of Wednesday, June 4th, the "May Lecture" of the Institute of Metals will be delivered by Dr. F. W. Aston, F.R.S., whose subject will be "Atoms and Isotopes." The same evening members and their ladies will be invited by the Rector of the Imperial College of Science and Technology, Sir Thomas H. Holland, K.C.S.I., K.C.I.E., and Lady Holland, to a reception at the Royal School of Mines. The official banquet will be held in the evening of Thursday, June 5th, at 7.30 p.m.

The closing session of the Congress will be held at the Exhibition in the forenoon of Friday, June 6th, for the consideration of resolutions and other business. Further particulars may be obtained from the General Secretaries of the Congress, Cleveland House, 225, City-road, London, E.C. 1.

ANOTHER important deposit of copper ore has recently been discovered on the Rhodesia-Congo border at N'Changa.

Wireless Communication with Lightships.

THE problem of communicating with lightships by means of electric signalling devices practically remained unsolved on an economic basis until the advent of wireless telegraphy and telephony. In the early days attempts were made to signal by the direct transmission of sound waves set up by mechanical means and received by submerged microphones encased in water-tight chambers. Inductive and leakage currents were also used. Even when these systems were replaced by direct telephone working practical difficulties were not overcome, for the usual chafing of the cables on the sea coast frequently led to breakdowns, such as are common to all submarine work, and one of the principal troubles was at the lightship, where the veering cable frequently broke down. Sometimes the repair of this portion of the circuit is within the skill of the lightship keeper, but the work often involves the dispatch of a repair ship, when considerable expense is involved. Recent advances in the development of wireless telephony, however, appears to have solved the problem, and in an article published in the January issue of the Post Office Electrical Engineers' *Journal*, Mr. F. Tandy describes the work that has been carried out in this connection.

For some time past communication has been established on the Mersey between the lightship at the Bar and the offices of the Mersey Harbour Board, and as the system has given satisfactory results, the Trinity House authorities have decided to apply the scheme to the light vessels anchored in the mouth of the Thames. On March 20th, 1923, telephone communication was established between the North Goodwin lightship and the Ramsgate Post Office. The plant on the lightship was installed whilst the ship was in dock, the aerial being supported by the main mast which carries the "light" and a spar hanging over the stern. The aerial consists of two copper wires separated by spreaders 12ft. long, and it can be raised or lowered as desired. The ship apparatus—shown in Fig. 1—consists of transmitting and receiving gear, together with an arrangement for calling the Ramsgate Post Office. The type of apparatus used is that generally employed when portability is required. A similar set has been installed at the Ramsgate Post Office. Calling from this point is not provided for, but a bell apparatus responds to the calling device on the lightship. Four other lightships are to be furnished with calling and speaking apparatus for working in conjunction with the Ramsgate Post Office whilst in due course other lightships will be placed in communication with another depôt. All the apparatus is extremely compact, and although the wiring is mainly enclosed, the various parts of the apparatus can be detached and the whole can be examined with ease. The ship stations differ somewhat from those on the shore.

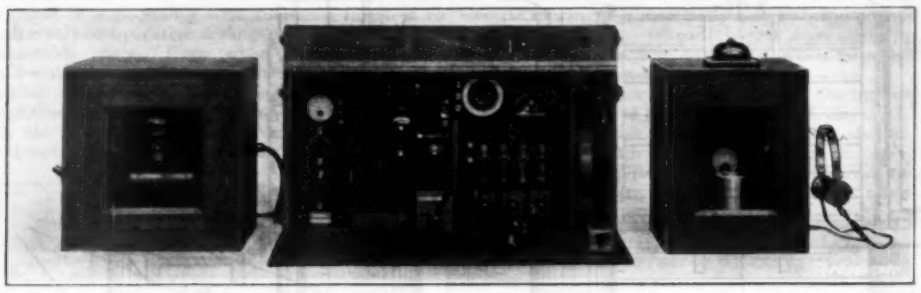


FIG. 1—LIGHTSHIP TRANSMITTING AND RECEIVING APPARATUS

In the former case petrol or paraffin power plants are used for charging the accumulators and for supplying the voltage necessary for exciting the telephone transmitting apparatus, whereas in the latter case the current for these purposes is obtained from a small motor generator worked from the supply mains.

The aerial at the Ramsgate Post Office consists of a 7/19 copper wire about 80ft. long with a down lead of about 30ft. to the roof. It is supported by a 50ft. light creosoted pole erected on the roof of the post office, as shown in Figs. 2 and 3, the distant end of the aerial being connected to an existing pole 120ft. from the post office pole. The wire is insulated by four porcelain rod insulators 18in. long, and the lead insulator which is made of ebonite composition, is of the mushroom or umbrella type. A copper net on the roof provides the earth connection. The erection of the pole on the roof was somewhat difficult, and two temporary gallows poles had to be employed, so that the intermediate lifting of the main pole could be carried out without inconvenience.

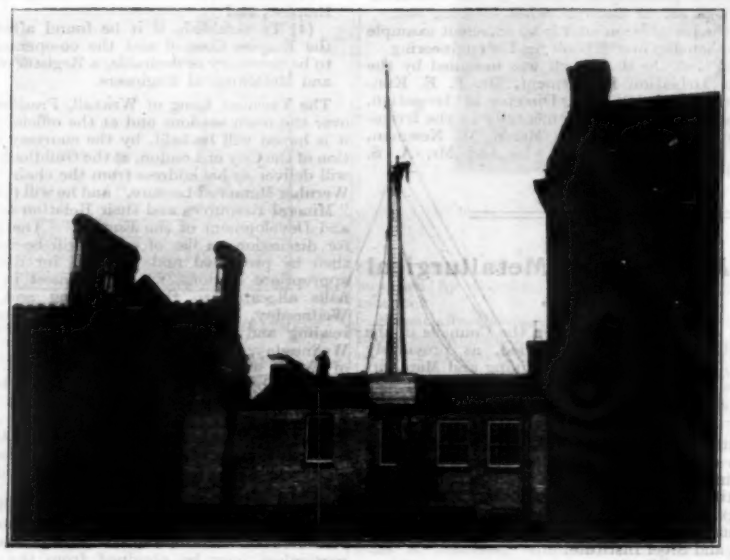


FIG. 2—AERIAL POLE AT RAMSGATE POST-OFFICE

FIG. 3—ERECTING AERIAL POLE AT RAMSGATE POST-OFFICE

In order that the transmitting and receiving apparatus might be under constant observation they were placed in the telephone exchange, whilst the motor generators and accumulators were placed in an adjacent room. The motor is supplied with current from the public mains, the generator having a double armature which gives a pressure of 1500 volts for the anode of the transmitting valve and also a low pressure for charging the accumulators. It was found, however, that this motor generator was incapable of fulfilling the practically constant charging conditions at the post office, and it is now only used for supplying the high pressure necessary for the transmitting valves, the cells now being charged in series with the ordinary exchange cells.

The diagrams—Figs. 4 and 6—show the connections for the transmitting and receiving apparatus. The transmitting panel contains the aerial tuning inductance 10 and ammeter for the aerial current, a 100-watt valve 9, and a by-pass condenser 12. There is also supplementary apparatus, including a condenser 5 for smoothing the high-tension current, a choke coil 6 for preventing ripple currents from the generator, an air core coil 7 to prevent high-frequency oscillations reaching the generator apparatus, and an aerial blocking condenser 8 for preventing the high-tension circuit being short-circuited. In connection with the aerial tuning inductance, which is designed on the variometer or rotating coil principle, a reaction coil 11 is provided, and is coupled to the aerial coil to produce the oscillations and set up the carrier wave. The anode voltage is 1500, and the current for heating the filament is 1.2 ampères.

An ammeter in the aerial circuit records the aerial current, which indicates whether the high-frequency apparatus is operating properly. When the transmitting valve is oscillating, the reactance must be so adjusted that the grid variations due to the speech do not vary the potential of the grid excessively, either positively or negatively, so as to prevent oscillating. In the event of excess current in the microphone circuit, a resistance is introduced into the circuit. A Morse key can also be brought into use instead of the microphone. Within the same compartment that contains the transmitting accessories, there is a small buzzer and tuning system with the aid of which the wave length can be determined. A second panel contains the tuning devices in connection with the receiver, which consist of an aerial series condenser, a variable inductance and reaction coil. The inductance is split into two portions, and by means of a two-way switch, it can be connected up in the most suitable manner for the reception on either of two wave lengths with maximum efficiency.

A panel associated with this equipment contains the detector and amplifying valves. There are four valves in all, which are coupled with the ordinary intervalve transformers. The first two valves act as high-frequency amplifiers, and the last valve as a note magnifier. The grid control of the second valve is obtained by means of a tap on a potentiometer resistance, and there is an additional resistance in series which supplements that over which the contact slider passes. The filament currents are regulated by a common resistance. An additional supplementary resistance is, however, used for the third valve,

which is specially adapted for rectification. It is found in practice that jamming can best be eliminated by working this "Q" valve at a comparatively low degree of incandescence, whereas in the case of the other valves a fairly high temperature is employed. The usual method of tuning is adopted, the maximum volume of speech being obtained when the reaction coil is adjusted just below the oscillation point. The capacity and inductance cover a fairly wide range above and below that of the wave length for which the apparatus is designed. The four valves mentioned operate in conjunction with two additional valves associated with the call receiving device, so that in all six valves are used to receive a call. The call apparatus is to be seen in Fig. 5. Each of the high-frequency transformers has a tapping, so that the whole

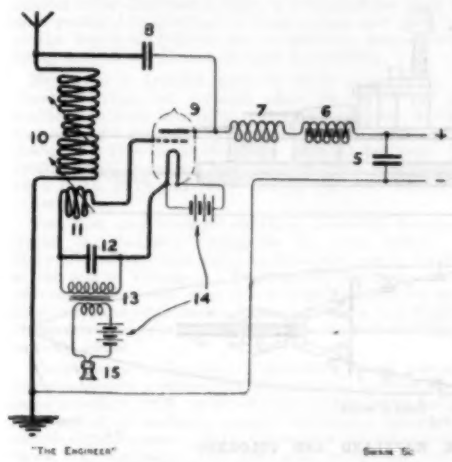


FIG. 4—CONNECTIONS FOR TRANSMITTING APPARATUS

or half of the windings can be brought into operation as desired, thus enabling the set to be worked at maximum efficiency on two definite wave lengths, the connections being altered by means of press buttons. Tuning is sufficiently flat to allow a margin of 20 per cent. above or below the wave length for which the receiver is designed, whilst the potentiometer adjustment of the third valve permits of very sharp tuning, and in view of the proximity of the lightship to the Channel, this is an essential feature.

As at the present time the installation only permits of calling in one direction, namely, from the lightships to the Ramsgate Post Office, calling apparatus has only been installed on the lightship, and receiving apparatus has been installed at the post office. The principle that has been followed is to utilise the carrier wave transmission of the ordinary speaking circuit while a signal of lower frequency modulates the carrier wave. On the calling apparatus provision has been made for generating four frequencies, and if the receiving devices are tuned to these frequencies, four stations can be called on a selective basis. This condition does not, however, have to be met in practice, and only one low-frequency adjustment has been necessary, the best frequency being chosen to meet the local conditions.

The call transmitter comprises a valve and complete oscillatory circuit, which determines the low-frequency alterations in accordance with the capacity of the circuit connected with it. These oscillations are carried forward to the high-tension circuit of the main transmitting valve ordinarily used for speaking purposes, with the result that the outgoing oscillations are modulated at a frequency which is determined by the control of the low-frequency valve. A mechanical device is associated with the low-frequency transmission circuit, whereby by means of a dashpot and a plunger system the low-frequency currents can be established for periods dependent upon the time constant of the dashpot, which can be made to vary from a period of 5 to 45 seconds. The operation consists of pulling down a handle which is held by an electro-magnet, a circuit of the latter passing through the dashpot. The duration of the signal is thereby controlled, and at the termination of the signal and at the end of the allotted period, it automatically interrupts the circuit and the calling magnet is de-energised. The working operation, therefore, consists of starting the normal transmitting valve with the switch in the send position, and subsequently operating the automatic calling device, which in turn modulates the waves transmitted.

The modulated waves are received with a normal

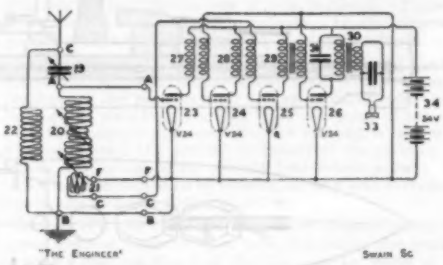


FIG. 6—CONNECTIONS FOR RECEIVING APPARATUS

apparatus, but at the end of the amplifier system they are passed into apparatus known as a call receiver, where further amplification and tuning takes place. There are two receiving valves in circuit with a loosely coupled variable inductance, the secondary of which is connected with the grid circuit of the first valve of the call receiver. Accurate tuning by means of a variable condenser to the particular note frequency allocated is here arranged for, and the transformer is coupled so loosely that selection is of a very refined character, so that wave lengths that are not required are eliminated.

The plate circuit of this first valve is inductively coupled to the grid circuit of the second valve, which contains a grid condenser and the leak, together with the secondary of a reaction transformer. This reaction transformer, it will be understood, is between the grid condenser and the grid, and its primary coil is associated with the anode circuit. The transformer has an iron core, but as there is no speech at this point, any phase displacement will not interfere with the character of the received signal, which eventually operates the relay. It is found that the introduction of reaction in this manner gives a considerable increase in the working range of the apparatus.

As the filament is always incandescent under working conditions, there is a continuous flow of current to the anode, and this current is made to hold the tongue of the relay against the spacing stop. When, however, a signal is received and the grid is made sufficiently negative to reduce the current, the relay moves to the marking stop, thus completing the circuit through the dashpot relay. This dashpot is tuned in the same manner as the one which controls the duration of the signal at the transmitting end, and once set in motion by the relay it completes its travel and operates the bell. This dashpot consists of a cylindrical tube filled with paraffin, and determines the rate of the rise and fall of the armature, which is regulated by a cam which gives the necessary adjustment for the play over a wide period of time. The operation of the apparatus, therefore, largely depends on the fact that in the ordinary operation of other transmitting systems the transmitting key would not be held down for a sufficiently long period to produce interference with the working of the call device at the Ramsgate Post Office, and it remains to be seen to what extent this conclusion holds good in practice. Originally the set was designed to work on a wave length of 320 m., but as interference was found to affect the working adversely, the wave length was subsequently reduced to 250 m., and that involved altering the aerial. The specification for the work was prepared by the Trinity House Authorities with the assistance of the officers of the Engineer-in-Chief, and the apparatus was constructed and installed by the Marconi Company,

FIG. 5—APPARATUS AT RAMSGATE POST-OFFICE

Training of Aircraft Apprentices at Halton Camp.

No. I.

By the courtesy of the Air Ministry we were recently enabled to inspect Halton Camp, near Wendover, in Buckinghamshire, which is one of the three centres devoted to the training of aircraft apprentices. The primary object of our visit was to see some newly erected barracks, which have been specially designed for the accommodation of the lads under training and which are regarded as being the last word in barrack construction; but the numerous other interesting features which came under our notice led us to seek permission to describe not only the barracks themselves, but also the camp in general, and to refer as well to the special training which is given to the youths while they are in residence. That permission was readily granted and every facility given to us to obtain any information which we might require.

Before commencing our description it will be well, perhaps, if we give some explanation of the training given, and of why it was found necessary to establish the three training centres which are at Halton, at Cranwell, in Lincolnshire, and at Flowerdown, near Winchester.

The great increase in the technical *personnel* consequent upon the rapid expansion of the Royal Air Force during the latter part of the war, made it necessary to start training boys, who were destined to enter the service, while they were still under military age. For that purpose the workshop buildings erected in connection with Halton aerodrome were in use as early as towards the end of 1917, living accommodation being provided in the hutted camp previously occupied by infantry under training.

Halton Camp, it may be explained in passing, was originally formed, comparatively early in the war, as an establishment for the training of two divisions of Lord Kitchener's Army. It consisted, in the first instance, of a large accumulation of huts of various shapes and sizes, as well as larger buildings, many of them of a more or less temporary character, and was erected on ground lent to the Government for the purpose by the late Mr. Alfred Charles de Rothschild. Subsequently, the site, which has since been purchased by the State, was converted into a training centre for mechanics of the Royal Flying Corps, and is now entirely devoted by the Royal Air Force to the training of lads who are being taught various trades, all of which are necessary for the efficient maintenances of aircraft.

It was early recognised that, when the war ended, there would necessarily be an exodus of skilled tradesmen from the Royal Air Force, and that both the needs of the Service and the interests of the country required that the training thus begun should be continued, rather than that the young men concerned should be thrown upon the labour market at a difficult time, some of them with insufficient experience to enable them to earn their own livings. At the same time it was realised that, under normal conditions, the Royal Air Force would find it difficult, if not impossible, to attract a sufficient number of highly skilled tradesmen for direct enlistment in its ranks in competition with civil firms. There was one other point which is, perhaps, not generally appreciated at its proper value, and that is that the two classes of operatives required in the largest numbers—aero-engine fitters and carpenter-riggers—are types of skilled craftsmen who do not exist in any numbers amongst the civil population, as there are, at present, no extensive training grounds for them in the civil industries of the country; in other words, the development of aircraft has led to the creation of new types of skilled mechanics. The Air Force, therefore, found itself forced to rely largely on a regular flow of boys, whom it must train itself, to provide the regular, and, at the present time, expanding needs of the Service, and as it was felt that since there was no alternative to training, it was decided that the desired results could be best assured by a system of entry which would attract boys of good education who would be likely

to show the best return to the Service for the cost of their training.

As a result, the existing aircraft apprentices scheme was formulated, and the first course of training was entered upon at another Royal Air Force station in 1920 by some 250 boys, who finished it early last year. Halton received its first entry in February, 1922, when a sufficient number of men had been trained and passed out to allow of hut accommodation being available, since the new barracks which were built specially for the boys could not be brought into use until towards the end of that year. The technical success of the scheme is already assured, and it may be recalled that, in its report on the conduct of the Air Ministry, the Select Committee on Estimates stated that it was of opinion that the management and training of the boys was conducted in a very efficient manner, and that it was much struck with the discipline, with the order which was kept, and with the arrangement by which they were efficiently taught a trade, which, when they left the Service, would enable them to earn a good living. It may be mentioned, too, that the Board of Education has also conducted a special examination into the management and organisation of the schools, and has expressed its general satisfaction, both with the nature of the training given and with the results which have been obtained.

The Choice of Apprentices.

The Air Force authorities themselves state that, undoubtedly, the success of the scheme has been largely due to the help which has been accorded by the educational authorities of the country in nominating boys of a suitable class and with a disposition towards a mechanical and technical career. There are, approximately. 350 educational authorities in England, Scotland, Wales and Northern Ireland, and most of them have already nominated boys for previous examinations. Any nominating authority can arrange for one or more examination centres as it may consider desirable. Kent, for instance, has had as many as seven or eight centres on the occasion of each examination. For the last two years the average number of centres has always been over 200, and the centres have been as widely separated as the Orkneys in the north and Penzance in the south-west. No boy, therefore, need experience any difficulty in securing nomination, or in attending the examination. The system of local nomination and examination presents several advantages, both to the boy and to the education authority. So far as the boy is concerned, the examination is brought almost to the door of his house, since the actual arrangements as to the place of examination are left to the authority concerned, the papers being supplied by the Air Ministry, to which the scripts are returned after the examination for correction and assessment. The boys are, therefore, able to take the examination in a single day, in surroundings to which they are accustomed, and without strain. So far as the education authorities are concerned, the system enables headmasters in their schools to recommend boys for a useful career which provides the youths, with no expense to their parents, with a sound technical training, and with a continuance of their general education several years beyond the usual school age.

The apprentices are entered under one of two systems :—

(1) *Limited Competition.*—Boys of from 15¼ to 17 have to obtain a nomination from a local education authority, or other authorised scholastic body, and to sit for an Air Ministry examination, held, half yearly, at different centres in the country, according to the number of candidates.

(2) *Open Competition.*—A half-yearly examination is held by the Civil Service Commissioners. In conjunction with this examination provision is made for the entry of the sons of officers, warrant officers, and non-commissioned officers, not below the rank of sergeant, who are only required to reach a qualifying standard. The syllabus, which is the same in both examinations, consists of mathematics, experimental science, and a general paper. It has been designed to be suitable for boys still at school and following a normal course of instruction. The Civil Service examination, the entry fee for which is, by the way, 5s., was this year held simultaneously in London, Birmingham, Belfast, Chatham, Edinburgh, Plymouth and Portsmouth.

For the Air Ministry examination there is no entry fee. Boys who are still at school and who wish to enter for it apply to their respective headmasters with a view to securing a nomination from the educational authorities responsible for the school. In the case of boys who have left school, application may be made to the Advisory Committee for juvenile employment in the area, while Boy Scouts can apply to the authorities of the Boy Scout Association and Territorial Cadets to the officer commanding their unit.

The majority of the boys come from junior technical schools, with a proportion from grammar schools, and have had quite a good education before they join. Entries are received in February and September and are attested in the Royal Air Force, on passing a stringent medical examination, for three years as aircraft apprentices. They engage to serve ten years from the age of 18, and two years reserve service afterwards.

Method of Training.

Selection to trades is carried out according to service requirements, but, so far as possible, choice of trade is given, preference being by order of merit in the entrance examinations. After a fortnight's disciplinary training, an apprentice begins his work in workshops and school. For the first year in the workshops he learns his trade only, without any special application to the Air Force requirements, but after a year he is examined in practice and theory and is allotted a Royal Air Force trade, and for the last two years of the course he continues to learn his trade as well as the Air Force adaptation of it. For example, an apprentice entered as fitter works only as such for the first year, though he is given opportunities to learn about elementary blacksmith's work, marking off, drilling and shaping, in so far as his trade is concerned, so as to develop his general interest and experience in the workshops. After his first year he may become a Fitter-aero-engine, a Fitter-armourer, or a Fitter-driver-petrol, &c., but throughout his succeeding two years, at least half his time will be devoted to improving his skill as a fitter, pure and simple. This arrangement is to insure that first, and above all, he shall be a skilled tradesman able to apply his knowledge to the requirements of the Air Force.

The workshop instruction staff consists of officers who are skilled engineers, with a proportion of specially selected N.C.O.'s and a number of civilian instructors who are chosen with due regard to their capacity to show and impart a high degree of manual skill. Throughout their workshop training the apprentices are taught to work to drawings, naturally beginning from the simplest exercises. During the first two years of the course the apprentices have to attend school as well as carry on their workshop work, and are taught by a staff of University trained masters. The school syllabus for the first two years includes :—Practical mathematics with revision of arithmetic ; algebra to quadratic equations ; logarithms ; the slide rule and geometry, with differential and integral calculus for the more advanced apprentices ; engineering drawing, including reading drawings and hand sketching ; engineering science ; measurements ; constitution and properties of matter ; energy and heat and electricity. There are also general studies and English to broaden the basis of study and to enable the apprentice to read intelligibly for himself. The aim is to give each boy a good general education and to develop his brains and theoretical activities in the best possible manner.

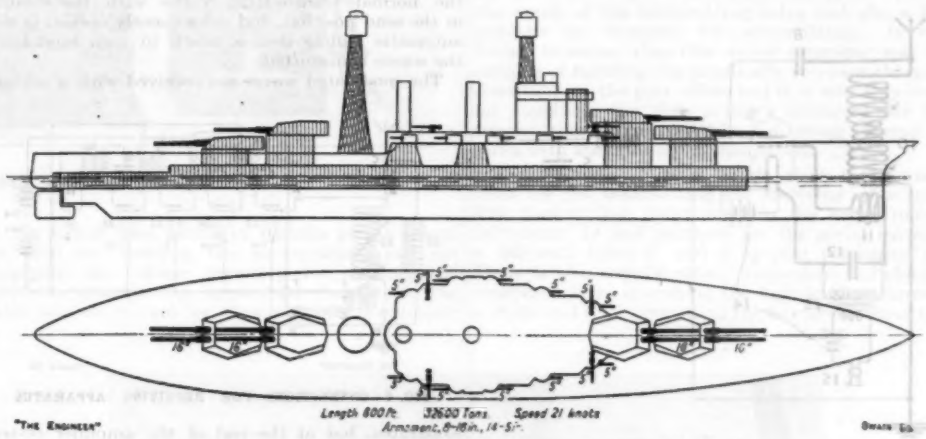
After the school examination the last nine months of school work are devoted to instruction of a practical nature to help the apprentices in their workshop work, the subjects including the following :—Materials ; elementary metallurgy of ferrous and non-ferrous metals for fitters, &c. ; and non-metallic materials for other trades ; revision of measuring instruments ; machine drawing ; technical writing ; theory of engines and aeroplanes, &c., according to trade.

During the period of training there are careful supervision of health and general welfare, medical attendance, religious instruction from the chaplains of several denominations, and, as has been said, recreation facilities. Pay is given, under existing regulations, at the rate of 1s. 6d. per day until the age of 18 is reached, and, thereafter, at the rate of 3s. per day until the course of training is completed. At the end of the course, the apprentice must sit at a passing-out examination for promotion to the rank of leading aircraftsman with pay varying from 5s. 2d. to 5s. 6d. per day. These rates may be subject to revision in the near future. Those boys who do not qualify for the highest grades are appointed as aircraftsmen with slightly lower commencing rates of pay. During the period of training, six weeks annual leave is granted.

A certain number of leading apprentices are sent, on completion of their course, to the Royal Air Force Cadet College at Cranwell for training as commissioned officers. Others are given an advanced course, and are eventually appointed N.C.O.'s with the rank of corporal. There is also a reasonable chance of selection for a further number to qualify later in flying so as to become airmen pilots, and generally there is an opportunity for promotion to the senior N.C.O. and warrant officer ranks.

U.S. Battleship Colorado.

In our article on the United States Battleship Colorado, which was published in our last issue, a diagram of the Battleship California was, by an inadvertence, given instead of one of the Maryland. Diagrams of both vessels were given on the same page in a past issue of The Engineer, and, in error, the wrong block was lifted. A correct diagram of the Maryland which the Colorado resembles is given herewith.



DISTRIBUTION OF ARMOUR ON THE MARYLAND AND COLORADO

SIXTY YEARS AGO.

The introduction of the metric system of weights and measures into this country was a subject which sixty years ago was receiving much attention. In a paper read before the Society of Arts by Mr. Samuel Brown, and printed in our issue of January 29th, 1864, warm advocacy of the system was advanced and a review was given of the progress made in its adoption in the principal continental countries. Serious efforts to secure its introduction into this country were begun in 1851, when the Society of Arts drew the attention of the Government to the importance of having a uniform and general system of weights and measures. These efforts culminated in the introduction of a Bill in Parliament in the middle of 1863, under which it was proposed that the metric system should be made obligatory in this country after a period of three years had elapsed. In spite of the fact that the Bill was opposed by the Government on the ground of its obligatory as opposed to its permissive character, and because it was held that the country was not prepared for the great change involved, the Bill received a second reading. It was decided, however, to defer proceeding farther with it until some measure of agreement could be reached regarding the subject. Mr. Brown dwelt on the particular and general advantages to be obtained by the adoption of the metric system, especially emphasising the view that the United States would adopt it as soon as we did and only hesitated to do so independently of us because of the fear that by so doing their large trade with this country would be disturbed. . . . We noted a short time ago that interest had been excited by the finding of what appeared to be original photographs signed in at least one instance by James Watt, and representing, among other things, his house at Birmingham. Their authenticity was doubted, although the Lunar Society, of which Watt was a member, was believed to have engaged in photographic experiments. It seems that a similar association with photography was believed in by some on the part of Josiah Wedgewood, the potter. A photograph had been found among Wedgewood's papers, but at a meeting of the Photographic Society of London, which was briefly reported in our issue of January 29th, 1864, this photograph was confronted with another "from the same negative," which it was stated by the exhibitor had been taken by Fox Talbot about 1843. This confrontation, however, did not end the mystery, for it could not be explained how a photograph by Fox Talbot had come to find a place amongst the Wedgewood papers. In addition, it was discovered, so it was reported, that Wedgewood's agent for the sale of his pottery in Paris was named Daguerre.

The Iron and Steel Institute.—The announcement is made that the annual general meeting of the Iron and Steel Institute will take place on Thursday and Friday, May 8th and 9th, at the House of the Institution of Civil Engineers, Great George-street, London. The annual dinner will be held on the evening of Thursday, May 8th, at the Hotel Cecil, Strand, W.C. The arrangements for the autumn meeting are not yet definitely settled, and the date and place of the meeting will be announced later. Members are reminded that in March the Council is prepared to consider applications for grants from the Carnegie Fund, in aid of research work on some subject of practical importance relating to the metallurgy of iron and steel or allied subjects. Special application forms can be obtained from the secretary of the Institute. The results of research work must be communicated to the Institute in the form of a report.

Railway Matters.

ANSWERING recently a question as to whether the Government Bill for dealing with the railways in the Free State would include the canals, the Minister of Industry and Commerce replied in the negative.

CONTRACTS have been let by the London Electric Railways Company for the sinking of the shafts for the tubes on the Morden extension of the City and South London Railway. Rotary excavators will be used in the construction of the tubes, and it is expected that they will move forward 20ft. to 25ft. per day.

THE London and North-Eastern Company's engine Locomotion, which was used at the opening of the Stockton and Darlington Railway in 1825, formed the leading exhibit in the Railway Jubilee in 1875, and has since been on a pedestal in Darlington Station, has now been taken to the North-road shops for overhauling, preparatory to being sent to the British Empire Exhibition.

BUSINESS in Ireland must be fairly prosperous. The Great Northern of Ireland, after paying 5 per cent. dividend in 1921 and 1922, is paying 6 per cent. for 1923, and adding a bonus of ½ per cent. for the second half of the year. The Great Northern paid 6½ per cent. from 1895 to 1907 inclusive, less for 1908–1912, 6 per cent. in 1913, 1918, 1919 and 1920, and 5½ per cent. in the four other years.

THE first step towards shutting down the locomotive works of subsidiary companies has been taken. The Maryport and Carlisle shops at Maryport are to be closed at the end of February. The local correspondent of the *Manchester Guardian* says it was a tradition of the fitting shops that the apprentices should go to sea, and hundreds of capable marine engineers have been trained at Maryport railway works.

THERE were no less than 5,620,073, or 5.81 per cent., more passenger journeys made in October last than in the same month of 1922. It is yet more gratifying to find that the number of workmen carried was higher than in any month since January, 1921. Passengers carried at reduced rates, *e.g.*, excursion and week-end, were also more in number than in October, 1922, but those booked at ordinary fares showed a falling off. There was an increase of 7.3 per cent. in the passenger train mileage, but, owing to the reduction in fares at the beginning of the year, there was a decrease of 6.22 per cent. in the receipts.

SINCE the Ministry of Transport was shorn of all its former glories, and since Sir Eric Geddes retired from the position of Minister, that office has been vacant. Questions in Parliament have been answered by the Parliamentary Secretary, and in order to meet those legal requirements wherein the "Minister of Transport" is specifically named, Sir John Baird, the First Commissioner of Works, has also acted as nominal Minister of Transport. In the new Government Mr. Harry Gosling is to be Minister of Transport, and it is one of the paradoxes of the situation that he was, until his appointment, the President of the Transport and General Workers' Union.

THERE are over 1,000,000 individual holdings in British railway stock. More than 400,000 are holdings of ordinary stock, and of these over 260,000, or 62 per cent., are for sums of £500 and under. Of the 400,000 preference stock holders, more than 220,000, or 54 per cent., of the holdings are for sums of £500 and under, while of the debenture holders, numbering some 220,000, nearly one-half hold £500 or less. Moreover, the bulk of the larger holdings are investments by assurance companies, friendly societies, trades unions and other organisations handling the savings of persons of small incomes, as well as by trustees and similar persons. Thus Mr. Bromley has not been fighting a "gang of capitalists," but, as in other respects, the middle and poorer classes.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the eleven months ended November 30th was as follows, the corresponding figures for 1922 and 1921 being added in brackets:—Locomotives, £2,604,111 (£4,785,110, £7,245,355); rails, £2,306,748 (£2,281,534, £2,757,300); carriages, £904,756 (£1,812,025, £1,445,978); wagons, £2,811,218 (£3,037,062, £5,551,973); wheels and axles, £893,628 (£1,100,970, £1,603,312); tires and axles, £627,367 (£391,588, £1,214,060); chairs and metal sleepers, £857,776 (£1,949,961, £1,346,523); miscellaneous permanent way, £1,155,518 (£1,284,753, £2,430,196); total permanent way, £6,125,124 (£7,178,045, £9,586,127). The tonnage of the rails exported was 258,105 (231,945, 148,552); and of the chairs and metal sleepers, 74,730 (137,703, 58,515). Locomotives to the value of £189,730 and rails to the value of £136,193 were shipped to India during the month of November last.

IT was forty-eight years on Monday, the 21st January, since the Abbots Ripton double collision, in which thirteen passengers were killed. At that period in railway signalling the signals stood normally at "clear," even where the block system was in operation, and were only "on" when a train was in the section immediately ahead. A snowstorm of unusual severity occurred that afternoon, and the signals at two signal-boxes failed to go from "clear" to "danger" when the signalman attempted to restore them behind a coal train. The up Scotch express found the signals at "clear" when it passed, and so collided with the coal train when the latter was being shunted at Abbots Ripton. There were no fatalities by this accident, but the *débris* fouled the down line and into it the Leeds express ran, and it was this second collision which led to the thirteen passengers being killed. Of Captain Tyler's report on the accident we observed at the time: "It is not too much to say that no more able or satisfactory report on a railway accident has ever been prepared by an officer of the Board of Trade. Logical and cautious as the summing-up of a judge it is, at the same time, lucid and complete. Nothing is left untouched that bears on the matter in hand; while all mere verbiage has been carefully avoided." The need for a continuous brake was made very evident in this case, whilst another was that signals should normally be at "danger." One result was the adoption by the Great Northern of a centrally-balanced arm which distributed the weight of any snow that collected on the arm.

Notes and Memoranda.

THE power plant employed in South African industrial concerns aggregates nearly 1¼ million horse-power. During the past three years the value of the plant installed has increased from £14,788,628 to £19,218,753. Throughout the Union there are electric motors of 630,000 horse-power.

AN article in the *American Machinist* describes how an engineer in India used steam heat for shrinking the runner and rotor of a large Pelton driven alternator on to its shaft. The shaft was 22in. in diameter, and the bore of the rotor was increased from 22in. — 0.003 to 22in. + 0.012 by heating it in a "steam box." The operation took about 10 hours for each piece weighing 8 tons. The total weight assembled was 53 tons.

ONE of the latest publications issued by Edgar Allen and Co., of Sheffield, is really more than an ordinary catalogue, although it is known as "Catalogue C." It deals with steel castings in a general way, giving hints as to the best system of ordinary castings and explaining the possibilities and limitations of the material. There are some historical notes and a reference to the process of grinding keyways in manganese steel gear wheels.

AN article in the house journal of Mavor and Coulson, discussing the use of compressed air for driving coal cutters, emphasises the necessity for the systematic reduction of leakage by mentioning a leak from one joint of the main pipe between a compressor and the pithead, a leak which did not attract the special attention of the officials, but which was going on for twenty-four hours a day. This leak was ascertained to be passing air at a rate corresponding to the value of £500 per annum.

RECENTLY the Geodetic Survey of Canada adopted a novel method in running a base line along the seashore in such a position that half the line is under water at high tide. The position is Oyster Bay, British Columbia, and the rough nature of the land formation left no option as to the place for the line. In spite of the fact that part of the line was under water for several hours every day, the marking posts driven into the sand held well and the measurements made while the tide was out proved entirely satisfactory.

ACCORDING to an article by M. Derclaye in the *Revue de Métallurgie*, nothing is gained by adding more oxygen to blast than the quantity which brings up the total oxygen content in the blast to 26 per cent.; the saving in pure carbon in this case amounts to about 100 kilos. —say, 2 cwt.—per metric ton of pig iron. This is self-evident if one bears in mind that the oxygen does not add to the calorific value of the blast, but a small quantity of it merely reduces the index CO_2/CO to its practical limit of carbon saving. Having reached this limit no further saving can be expected by adding more oxygen.

DISCUSSING the possibility of obtaining steam power from the heated centre of the earth, Dr. T. T. Read, of the American Department of the Interior, points out that the suggestion to pass water down a deep shaft and circulate it through large galleries at the bottom, thus giving it time to take up the heat, even at the slow rate of transfer that exists is impracticable. It would give us water at a high temperature and pressure, but at the bottom of the shaft, where it is no more useful than ice is in the polar regions. In rising to the top of the shaft, the hot water would cool down at about the same rate as it heated up in descending. Even with extremely efficient —and expensive—heat insulation on the up-going pipe, so much of the heat would be lost that what remained would not pay for the cost of getting it.

IN discussing the subject of spontaneous combustion at a meeting of the Midland Section of the Society of Chemical Industry, Mr. J. Ivon Graham said that the danger from spontaneous fires underground was likely to increase as years went on owing to the necessity for deeper mining under conditions of higher temperature and greater pressure on the strata. Two main theories regarding the phenomenon had been held for years—one that pyrites was the principal cause of the trouble, and the other that spontaneous combustion was the result of oxidation of the organic substances in the coal at ordinary temperatures. It was now certain that in some cases, both underground and on the surface, spontaneous heating resulted from the rapid oxidation of pyrites when it occurred in a finely divided condition. The greater proportion of trouble experienced in underground workings would appear to be caused by the nature of the coal itself. Many coals had been found to absorb oxygen rapidly at ordinary temperatures when freshly ground, with the evolution of heat. Increase in temperature caused an increased rate of absorption of oxygen, which, if not dissipated, would further raise the temperature of the material, and so the process went on until the coal would eventually fire.

IN the course of a general study of the properties of mud-fluids and cement used in oil and gas wells for the shutting off of encroaching underground waters, being made by the United States Bureau of Mines, laboratory tests are being made to determine the effect of different proportions of mixing water on the tensile strength of cement. The tensile strength of cement decreases as the amount of mixing water is increased after the chemical affinity of cement for water has been satisfied. A number of tests were made to determine the effects that crude oil has on the setting of cement. In one of these tests a ratio of 45 lb. of water to 94 lb. of cement was used, and the mixture allowed to stand in an oil bath. The cement took its initial and final set in the usual time, and the tensile strength of the cement at the end of fourteen days was normal. The results of these tests indicate that when cement is properly mixed with water before being placed in a well the presence of oil does not affect either the time required for the cement to set or its tensile strength when set. The numerous unsuccessful attempts to cement oil wells have been attributed to the presence of oil. This misconception probably arises from the fact that gas is usually associated with oil, and, if present in relatively small amounts, is likely to occasion agitation of the liquid cement, thus preventing a proper set.

Miscellanea.

THE town council of Torquay proposes to expend over £50,000 on waterworks extensions.

THE new Spennymoor sewage disposal works, which have cost some £33,000, were opened at the end of last week.

A NOTE in the *Canadian Engineer* states that the province of Quebec is opposed to the St. Lawrence deep waterway and power project.

THE total output of the Transvaal goldfields during last year is valued at £40,178,170. The lowest working costs, at the Simmer and Jack, were 14s. 11d. per ton.

THERE is a possibility of the Scottish shale oil industry being closed down, says the *Iron and Coal Trades' Review*, unless there is a considerable improvement in conditions.

THE inaugural lecture of the Ramsay Memorial Laboratory of Chemical Engineering was delivered at University College Chemistry Theatre on January 17th, by Professor E. C. Williams, who is the Ramsay Professor of Chemical Engineering.

THE sudden death is announced of Mr. A. C. Flint, who had been assistant secretary of the Chemical Engineering Group since soon after its inception, and who had also acted as assistant secretary during the formation of the Institution of Chemical Engineers and during its active life to the present time.

A NEW electric power main is to be laid between Wolverhampton and Cannock Chase at a cost of £35,000, while another one will go from Bridgtown to Heath Hayes. When the cable has been extended to Cannock Wood and round to the sub-station at Hednesford, a ring main will be complete. The voltage of the system is 6600.

BRITISH Columbia's mineral production for 1923 shows an increase of 12.8 per cent. in monetary value over that of 1922, according to a statement issued by the Minister of Mines. The output is valued at 39,699,758 dollars, as against 35,158,843 dollars for the previous year. The production of 1921 had a value of 28,066,641 dollars.

THE vanadium mines near Casapalca, in the Peruvian Andes, which were closed down in 1921, have resumed operations. It is expected that as soon as everything is in running order there will be a monthly output of approximately 1000 tons. The ore runs from 25 to 30 per cent. V_2O_5 (vanadic acid), and will be shipped to the United States for reduction.

THE Gatineau Company, which has its head office in Montreal, is seeking authorisation to develop nearly 100,000 horse-power by constructing a dam at a point known as Chelsea Falls, 8 miles north-west of Hull. This development, according to information available, will cost between 3,000,000 and 4,000,000 dollars. At the outset only half of the total horse-power mentioned will be utilised.

APPROXIMATELY 5,000,000 dollars will, it is reported, be spent by the Dominion Coal Company in opening up a new mine and colliery at Lingan, South Cape Breton, N.S. The construction of a branch line of railway to the new site has already been started. The new colliery will be equipped with every modern device, and will have a capacity of some 2000 tons daily. A model town is planned in its vicinity.

DURING 1923, 6475 vessels entered the port of Marseilles, as compared with 5712 in 1922. The quantity of goods imported amounted to 5,327,437 tons, as compared with 4,171,815 tons last year; exports totalled 1,907,337 tons, as compared with 1,652,970 tons in 1922. The pre-war figures—1913—were as follows:—8634 vessels entered; 5,886,217 tons of goods were imported, and 3,052,435 tons were exported.

THE death occurred recently at Plymouth, at the age of sixty-four, of Mr. T. Settle, consulting engineer. Mr. Settle, who was a native of New Mills, near Huddersfield, was formerly manager of the Golden Dagger tin mine, Dartmoor, and of the Gooseford arsenic mine, near Okehampton, and subsequently became works manager to the Exeter Gas Company. He was well known as joint patentee of the Padfield-Settle retort.

FURTHER danger to the levels of the Great Lakes and the St. Lawrence River, already seriously affected by the excessive diversion of water through the Chicago drainage canal, is threatened, according to Mr. M. P. Fennel, manager of the port of Montreal, by the commencement of construction work on the last link of the waterway designed to connect the present end of the canal at Lockport, Ill., with Lasalle, the head of navigation on the Illinois River.

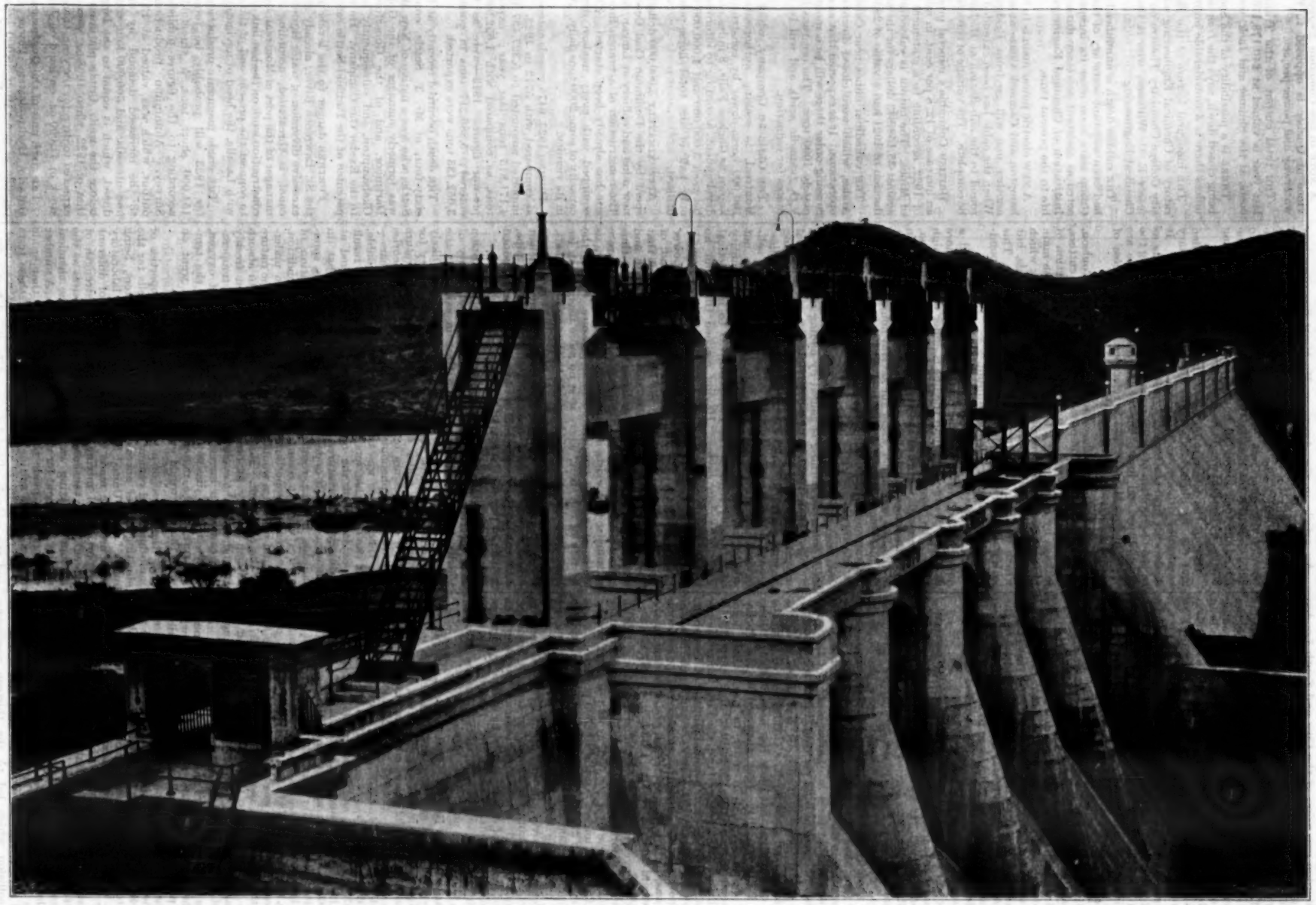
THE crude magnesite production of the United States for 1923 will probably be found to have exceeded 154,000 short tons, a threefold increase over 1922, according to the figures published by the Geological Survey. Aluminium production exceeded the 1922 output, which was valued at 13,622,000 dollars, owing to the increased demand by makers of motor cars and utensils, and 500,000 long tons of bauxite were produced, which is equal to the largest annual production before the war. Crude platinum production fell below that of 1922, when 1008 oz. were mined. Imports were expected to drop for the year, there being a total domestic stock of 41,000 oz. on hand on January 1st, 1924.

THE sixth unit of the Queenston-Chippawa plant of the Ontario Hydro-electric Power Commission, which is capable of generating 55,000 horse-power, was formally put into service on January 8th by Premier Ferguson, of Ontario. This addition increases the amount of electrical energy now available from this one plant to 350,000 horse-power. Sir Adam Beck, chairman of the Commission, announced the plans for further extensions, for which the approval of the Ontario Government was sought. The Commission is seeking authorisation to install units Nos. 9 and 10 of the plant, which would bring the total capacity of the system up to 965,000 horse-power by 1926; the appropriation of from ten to twelve million dollars for the establishment of auxiliary steam plants; and the construction of a dam near Morrisburg, Ont., which would make possible a 700,000 horse-power development on the St. Lawrence River.

LAKE MENTZ DAM ON THE SUNDAYS RIVER, SOUTH AFRICA

MR. F. E. KANTHACK, M. Inst. C.E., JOHANNESBURG, ENGINEER

(*For description see page* 116)



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THE ENGINEER.

FEBRUARY 1, 1924.

The Railway Strike.

AT an early hour on the morning of Tuesday last, January 29th, the railway strike came to an end. The terms of the settlement will be found in a Journal note in the present issue. In effect, the companies gain the contested point that the findings of the National Wages Board shall be accepted, but they consent to spread the incidence of the new regulations over a year instead of applying them in full at once. On its side, Mr. Bromley's association may claim that it has secured, in writing, a statement that the decisions of the National Wages Board are not obligatory. That is the whole result of a strike which brought grave inconvenience to millions of people, and, owing to exposure to inclement weather, fatigue and overcrowding in railway compartments, caused the serious illness and probably death, of not a few. Whilst, as will be seen, nothing of any moment was secured by the strike that could not have been equally well gained without it, its effect must, we fear, be to weaken in future the decisions of the National Wages Board. Once more, we are made acquainted with the deplorable fact that even the most carefully devised machinery for the prevention of industrial troubles can be broken down at once at the will of a few recalcitrant men. It is, however, a satisfactory feature of the settlement that, after all, the Associated Society was obliged to accept the finding of the Wages Board with no material modification. That the companies agreed to delay the full application of the findings we take to be due rather to a desire to end the strike at once than to any degree of admission that the findings were at fault or that the parties concerned were not morally bound to follow them.

The more one considers the terms of the agreement, the more difficult does it become to see anything of importance in them. The first clause is a declaration by the companies that they do not claim that the decisions of the National Wages Board "must be regarded as obligatory upon all parties to the proceedings." Since the powers exercised by the Board under its constitution are well known, and since the companies had already said that they did not regard the decisions as binding, there is but little weight in the clause. The companies add that "having taken into consideration all the circumstances of this particular case, they are justified in giving effect to the decisions of the Board." In this contention we must agree with them. The Board was composed of representatives of the men as well as of the companies; it was presided over by an independent chairman; it took throughout a very favourable view of the men's case; its decisions have been accepted by other grades of railway servants; and its report was signed by Mr. Bromley for the Associated Society of Locomotive Engineers and Firemen. The case of the enginemen was very carefully considered, and the decision that their rates should be reduced was a just one, even in Mr. Bromley's opinion, or he could hardly have brought himself to sign the "findings." In such circumstances, the companies were perfectly reasonable in deciding to give effect to the decisions. Since, however, these decisions are not binding, the men on their side could, within the law, oppose them, but that they should carry opposition to the point of striking was intolerable. The companies expressed their willingness to consider any cases of real hardship, and the men must have known very well from their dealings with the Railway Conciliation Boards that hardships could have been, and would have been, adjusted. No doubt, as relatively few men—no more than forty-eight—are seriously affected, the companies would have dealt with them individually instead of, as they now have agreed to do, in the mass. Under Clause 2 of the terms, they agree to bring about the modification of the basis mileage by stages. This mileage was originally, as we explained in our last issue, 150—that is to say, ten hours at fifteen miles per hour. When the railway day was reduced to eight hours, the mileage became 120. As an express run of 120 miles is readily performed in three hours, the drivers and firemen received eight hours' pay for three hours' work. After careful consideration, the Wages Board advised the restoration of the 150-mile basis. That figure is now agreed to by the terms of settlement, but instead of dating in full from Monday, January 21st, the mileage will be 130 till July, 140 till January, and 150 thence forward. For every fifteen miles beyond the basis mileage, wages for one hour will be paid. In the same clause appears a paragraph about the payment of drivers on shunting and similar duties. Its importance is not considerable, and the terms could have been settled by amicable discussion. Finally, the companies put in writing in the agreement, as they had previously done in their letters, that there would be no dismissals as a result of the adoption of the decision of the Wages Board.

In one respect, and in one respect alone, has Mr. Bromley achieved anything by a strike which has done serious injury to the country. He has secured a definite statement that the decisions of the National Wages Board are not obligatory. Since we ourselves regard compulsory arbitration with little or no favour, we may congratulate him on that success. But with this reservation—that, although the recommendations of the Board may not have the weight of law, it will be fruitless to waste time in future upon reaching them if they are not recognised as at least morally binding. We take it that after they have been promulgated, discussion as to their means of application may take place between the parties concerned, and that failing agreement, an appeal to the good offices of some other tribunal might be made. That the companies were quite ready to administer the decision with toleration is shown by their promise to consider all hard cases, and to dismiss no men. It must ever be remembered that they acted on the advice of an impartial body—the National Wages Board—and that, in consequence, there could be no question about the justice of the course they took. Had Mr. Bromley taken a kinder view of the companies, had he not been (as he himself declared that he was) bent on their spoliation, then the findings of the Board could have been applied without any disturbance of the railways. In any case, that Mr. Bromley should have ceased to make any further efforts towards peace and have plunged into a strike on the first day that the new regulation came into force, showed a lack of consideration for the public which it will not quickly forget.

Turbine Locomotives.

So far as new construction is concerned, as we pointed out in our annual review, locomotive engineering in the year just past presented few new features. In this country, however, certain trials of note have been made with the Ramsay turbo-electric locomotive which was built in 1922, and of which we have already given some particulars; and in Sweden another turbine-driven locomotive has also been in service. We understand that the Swedish engine has given such satisfaction that several more are being built, and whilst our information with regard to the Ramsay engine is scanty, we hear that it has some promising features, although the existing

example has an excessive axle load. In a broad way, these turbine locomotives are similar. They are both composed of two distinct units, one of which in each case carries the boiler and the second the condenser. The main difference lies in the method of transmitting the energy of the steam turbine, providing the motive power to the driving axles. In one instance—that of the British engine—this is accomplished electrically, whilst in the case of the Swedish locomotive mechanical means are provided in the form of gearing.

The two features named form the most important differences, and no doubt an interesting discussion could be made on the merits of each system. We, at the moment, merely propose to point out a few of the features of these locomotives which present themselves when viewed beside those of the common type. The Ramsay locomotive is, in effect, a complete electric power plant on wheels, and as such is unquestionably a very interesting and ingenious piece of construction. In it we have a steam turbine of the impulse type direct connected to an alternator supplying current to four main driving motors, two mounted on the boiler unit and two on the condenser unit, and in the design now under notice each unit is, in effect, a six-coupled engine, of 550 horse-power at the motor pinion. The power generated by the turbine, assuming the 890-kilowatt generator to have an efficiency of 92 per cent., will be about 1300 shaft horse-power, and the total weight of the locomotive, when ready for the road, is, we understand, 154 tons, or 268.7 lb. per horse-power. Compared with a locomotive of usual construction, and of about equal capacity, this weight appears high. We have in mind a class of eight-wheeled express engines having four-coupled wheels, and weighing, with fully loaded tender, 99.1 tons, capable of maintaining 1100 indicated horse-power at about 60 miles per hour, which gives but 201.8 lb. weight per unit of power developed. The total length over buffers of the Ramsay locomotive is 69ft. 7½in., and of the wheel base 59ft. 4in.; and when it is remembered that this figure must be compared with 70ft. 5in. and 60ft. 10½in. for the Gresley "Pacifics," and that the latter engines have a rated cylinder horse-power at approximately 55 miles per hour of 1945 and actually weigh 12,984 lb. less with the low weight of 170.8 lb. per horse-power, it will be recognised what a large machine the Ramsay turbo-electric engine is in proportion to its capacity. The other turbine locomotive to which we have referred is the Ljungstrom, of 1800 horse-power and weighing, in working order, 126.0 tons, giving a weight per horse-power of 156.7 lb. This engine is, therefore, much lighter than either of the other locomotives mentioned, while at the same time its general proportions are similar to the Ramsay locomotive, the total length and wheel base being 71ft. 11in. and 57ft. 6in. respectively. From these comparative figures it will be seen that the gear-driven turbine locomotive is considerably lighter than the turbo-electric type. The question of weight is important in this connection, owing to its effect upon draw-bar horse-power. In a general way it may be said that the greater the engine weight the less the draw-bar horse-power, because more of the power developed in the cylinders has to be expended on moving the engine itself. But in this respect the turbine locomotive has a marked advantage over the reciprocating engine by reason of its higher thermal efficiency, so that even a very much heavier turbine-driven engine might still burn less coal per draw-bar horse-power than a corresponding locomotive of normal type. Nevertheless, excessive weight is injurious, and we may expect to see efforts to reduce it in future designs of turbine-driven engines. In the design of locomotives considerable attention has, during recent years, been given to the elimination of weight; this has been occasioned by the consideration of two points of view, namely, axle loads and the desire to increase the work available at the draw-bar for a given effort at the cylinders. The weight per horse-power of the London and North-Eastern "Pacifics" mentioned is an example of what can be done in this direction, and is the more remarkable because it includes a tender loaded with 8 tons of fuel and 5000 gallons of water.

Hitherto, locomotive engineers in this country have shown a marked disinclination to introduce any avoidable complication; that being so, we hardly know how they will view the turbine-driven engine with its attendant condenser and other impedimenta. The information we have to the effect that the Ljungstrom engine is successful in Sweden, and a locomotive of the type has been ordered for trial on a South American railway, and that arrangements have been made for the making of this particular design in this country, are sufficient indication, however, that the type is passing through its experimental stage and becoming a practical competitor with the conventional type of steam locomotive. That a considerable reduction in the steam rate, and, hence, the coal required per horse-power, is obtainable, we have no doubt; but economy of coal and water, whilst of importance, is not everything. It does not, in our view, constitute by itself the measure of locomotive efficiency, though it is part, and an important part, in the problem, and it may be of more importance in Sweden and South Africa, and in other countries, than in this, where water, as a rule, is plentiful and good coal is relatively cheap.

Progress of Mechanical Engineering in the Military Service.*

By Major G. LEQ. MARTEL, D.S.O., M.C., R.E.

DURING the nineteenth century the work of the mechanical engineer in the Army was divided between the Royal Artillery and the Royal Engineers. The Artillery were responsible for all work in connection with guns, gun carriages and small arms. The Engineers dealt with all other branches of mechanical engineering. They carried out a considerable amount of pioneer work in adapting the progress of mechanical engineering for use in war. They dealt in turn with armour and steel construction, military railways, mechanical road transport and flying. The work of both the artillery and engineers came under the Master General of the Ordnance. In the twentieth century the scope of the mechanical engineer in the Army increased very largely, and this work was no longer kept concentrated under the Master General of the Ordnance, but was divided among four bodies—the Royal Artillery, the Royal Engineers, the Army Ordnance Department and the Royal Flying Corps. In addition, there was the Mechanical Transport Committee, which was a separate body dealing with mechanical road transport for the Royal Army Service Corps.

MUNITIONS, TANKS AND TRANSPORT VEHICLES.

Up till 1914 the Army had never seriously considered the production of munitions of war on a large scale. Some of the munitions had been designed in a manner which did not lend itself to mass production. Moreover, there were few munition factories, with a result that few civilian engineers understood the particular methods and difficulties connected with the production of munitions. A very great responsibility fell on Woolwich Arsenal in this respect. Not only had they to work their own factory to the utmost limit, but they also had to do their best to instruct and demonstrate to representatives from numerous firms and make every effort to place as much munition work as possible at industrial works.

When the Ministry of Munitions closed down at the end of the war, the whole of the work of design and production was taken over again by the Master General of the Ordnance. The Great War demonstrated the importance of equipping an army with the best and most up-to-date munitions of war, and it has therefore been their subsequent policy to carry out a considerable amount of experimental work. The end of the war left us with a number of inventions, some of which were only half developed—such as tanks, several new types of gun, bridges, transport vehicles, gas, explosive bullets, &c.—and many of these have been improved and tested during the last few years and developed in readiness for war. The cost of this work is not very great, and is quite inconsiderable compared with the great value which improved and new weapons render to an army in war. The work proceeds in stages, and at each stage a few models of the munition in question are produced and thoroughly tested, so that expansion could take place on that type in the event of war. In this way the obsolescent types with which our Army would proceed overseas would soon be replaced with the latest developments.

Of the design work carried out by the Ministry of Munitions, perhaps the most interesting work is in connection with the construction of tanks. Considerable progress was made during the war by the Ministry, and further progress has since been made by the branch of the Director of Artillery, who took over the work when the Ministry closed down.

The first few types of tank that were used during the war were adapted from the ordinary commercial or agricultural tractors. In most cases the tracks were taken right round the tank instead of being kept underneath, but with this exception they possessed no particularly novel features. No attempts were made to reduce weight and the tracks themselves were very heavy; the overall efficiency of the tanks was very low. Towards the end of the war, however, an attempt was made to construct a tank that would attain a speed of 20 miles an hour and travel 300 miles on the petrol carried. In order to achieve the desired result, a very great improvement was necessary in the mechanical efficiency of the tank. The first and obvious method was to reduce all unnecessary weight, particularly in the track itself. Then a new method of springing the track rollers was introduced which saved considerable weight. In the new tractor the rollers are mounted on bogies, and these bogies are supported by a cable. The cable is kept in tension by a spring. If a fairly large obstacle is encountered, several bogies are forced upwards and the spring is extended, but if small undulations are met some bogies rise and some fall, and the spring may not be extended. Thus the cable suspension acts both as a springing device and an equaliser, and, at any rate, from a theoretical point of view, it forms an ideal system of suspension. Great weight is saved by using one spring instead of a series of springs over each bogie. A tank was then constructed using this method of suspension, and a very much lighter form of track plate. The first experimental tank was completed about the date of the Armistice, and gave very astounding results. Speeds as high as 28 miles an hour were achieved. A further improvement in this design of tank had been to make the hull waterproof, so that the tank would float and propel itself across water with its tracks acting as paddle wheels. This was achieved across a river at Christchurch, but was only found to be possible where there was practically no current, as the tracks had very little power of propulsion in the water. But although the first trials with this tank gave such striking results, many mechanical troubles soon materialised, and these proved difficult to cure. It became evident that a good deal more applied research was necessary before such a tank became a practical proposition. In the meantime, the Tank Corps required to be re-armed, and it was therefore decided to concentrate on a less ambitious tank which could be built with the knowledge already possessed, but which was, nevertheless, a considerable improvement on the war tank. The tank eventually decided on was the Vickers tank. It achieves a maximum speed of about 15 miles an hour, and will travel about 100 miles on the petrol carried. It weighs 10 tons.

After the Armistice the question of replacement of horse transport by tractors was discussed very fully in many military journals. It has been pointed out that the difficulty of transport in the forward area had a large share in the failure of most of the offensives in the latter part of the war. During the long period of trench warfare the great armies just existed on a perfected system of road and rail transport; but after the initial stages of an offensive, the railways were non-existent in the forward area, and the roads very much damaged. It is therefore hardly surprising that every offensive was seriously affected by difficulties in transport. In open warfare, the vulnerability of transport which is tied to roads is also very serious, particularly if the enemy possesses an active air force. Then, again, in warfare against an uncivilised enemy the one great problem has always been the difficulty of transport. A suitable type of cross-country tractor would solve all these problems, and all thinking soldiers are now convinced of the desirability for this change. Moreover, the tractor which brings with it economy in tonnage and man-power also brings economy in expense, and this is a matter of primary importance under peace conditions.

But the change over from horse-drawn transport to tractor transport entails great difficulty from the point of view of mobilisation. Before the war the Army only retained a small amount of transport in peace time; for war the Army obtained horses and lorries from civilian sources, and so expanded their transport to the size necessary in war. Therefore, if our present transport is to be changed to track transport, we shall have to keep our full requirements in the Army during peace time, because there is at present no known source of supply from civilian resources. This may well be possible in the artillery, where the saving effected by the introduction of tractors is so very marked, but the maintenance in peace time of the whole tractor transport required by an army for every purpose would entail a prohibitive expense. It seems clear therefore that we shall not succeed in achieving the very desired result of mechanicalising all our transport until the civilian world can supply the necessary tractor transport with which we can mobilise for war.

The problem therefore reduces itself to one of persuading the civilian to use track transport, and in order to do this we must be able to give a satisfactory answer to the first question which he will ask, namely, What is the running cost of the tractor as a means of transport? At the end of the war the best commercial or agricultural tractors could not produce an overall efficiency of much more than 20 ton-miles per gallon under normal conditions, and as a lorry on the road could easily produce 50 ton-miles per gallon, the outlook for an extended use of tractor transport did not seem very hopeful. And yet, if this figure of efficiency can be improved, the tractor has, on basic principles, very many advantages.

There is a definite demand for tractor transport from the Colonies, and there will be a ready market as soon as an efficient tractor is produced. Land

* Institution of Mechanical Engineers. Abstract of a lecture delivered in London, Friday, January 25th.

which is at present valueless, owing to lack of roads and railways, will become valuable, and the cost of transport will fall rapidly in the Colonies with the introduction of tracked vehicles. If this market can be stimulated we shall be able to draw on the export trade of this country for war. There is a further possible source of supply. Some 50 millions of money are spent a year on the upkeep of the roads in this country, and the damage to them is almost entirely due to the commercial lorries. If we could produce and universally adopt a tracked vehicle which is as efficient, or nearly as efficient, as the lorry, the great part of this 50 millions could be saved. The saving effected would enable us to subsidise the replacement of the commercial lorry by the tracked vehicle. Cars and light vans on wheels could still be used, because they do practically no damage to the roads. This step is not within the bounds of possibility at the moment, and it is too early to say whether it will eventually be possible, but it is well to remember that the mechanical engineer is seldom defeated by any problem, and the production of a tracked vehicle as efficient as a lorry is only a somewhat intricate mechanical problem.

Imbued with these ideas, we set out at the end of the war to try and produce a tractor which would suit the requirements of the Army, and would also be sufficiently economical—both in efficiency and wear and tear of parts—to be used for commercial purposes, particularly in the Colonies. The first step was to ascertain the main causes of the low efficiency of the tractor. One very large factor is connected with the method of steering which is adopted on all commercial tractors. This method consists of applying all the engine power to one track and using a brake on the other track so as to force the tractor to skid round to the desired angle. The inner track stops momentarily while the skid is taking place.

One of the first steps taken, therefore, was to try and produce a better method of steering. An entirely new method was suggested about four years ago by Colonel P. Johnson, D.S.O. His idea was that the track should be constructed in such a way that it had lateral flexibility and that it should be suspended on the type of cable springing already described. In this way the track would be able to be laid in a curve and the tractor could negotiate easy curves without skidding. When the power is applied to one track only, the tractor swings through an angle, but the portion of the track which was resting on the ground remains in that position. Thus the track takes on an "S" form. As the tractor proceeds, it lays the track on the new alignment so that no skidding need take place. The tractor can, of course, only swing through small angles in this way, or describe easy curves, without skidding. A further advance consists of pivoting the front horns of the vehicle so that the track can be laid in a sharper curve. Alternatively, it may be possible to negotiate sharp bends by the use of two pairs of tracks of which the first pair can be pivoted like the forecarriage of a cart. Each of these pairs of tracks would, of course, need lateral flexibility so that they could be laid in a curve, but by using two short tracks a much sharper curve could be laid. Experimental models which have been constructed on these lines have shown a great increase in efficiency over commercial tractors, and this is mainly due to the skidless steering and the light tracks which can be used.

These experiments were naturally accompanied by a large number of minor troubles, such as tracks running off and breaking, &c. A good deal of research work was done and then the problem was left to be solved by the civilian world, who have carried on the work; but a great deal more applied research is necessary before a tractor of this nature can be produced which will be sufficiently economical for commercial use. There is, however, quite a possible solution by the use of a half-track vehicle, that is, a vehicle with wheels in front and short tracks instead of rear wheels. This greatly simplifies the problem of steering. Even with this type of vehicle a track which can be laid in a curve is desirable, but provided the tracks are short and do not carry much weight a fair efficiency can be reached with rigid tracks. At first it was thought that the front wheels would be a great disadvantage for cross-country work, but experiments have now shown that quite serious obstacles can be crossed with these half-track machines.

The Kegresse machines have stimulated great interest, but with their rubber tracks they are at present limited to fairly light loads. The track has practically no lateral flexibility and the overall efficiency of the machine is not high. Some British firms are now taking up this work, and one firm—Rondlers Traction, Limited—has produced a 2-ton vehicle which will carry a load of 1 ton over surprising cross-country obstacles and with an overall efficiency of some 40 ton-miles per gallon on fairly good going. It can maintain an average speed of 15 miles an hour on reasonable cross-country work. The tracks have lateral flexibility.

Our present position is as follows:—We are building tanks and tractors which have practically the same form of track and transmission. The machines are similar to the war tank or commercial tractor. The tracks are rigid and the machines steer by skidding round. At the same time a good many minor improvements have been incorporated. Every effort has been made to reduce unnecessary weight, with a result that speeds of 15 miles an hour can be attained, and a very satisfactory system of buffer-springs has been incorporated for springing the track rollers. These tanks and tractors are reliable machines and will do 1000 miles without serious overhaul or repair. Their overall efficiency is about 24 ton-miles per gallon. In the meantime models with improvements are being tested and will be introduced later; also progress in the civilian world is being watched with a view to the possibility of introducing more efficient tractors for general transport work, which might be drawn from civilian resources for mobilisation in war.

Considerable progress has also been made since the war with wheeled vehicles for motor transport.

The Royal Army Service Corps had to discover a type of lorry which would be capable of traversing indifferent roads or tracks and capable also of travelling at a fairly high speeds on ordinary roads without doing serious damage or breaking through thin foundations. A good solution has been found in the 30-cwt. lorry equipped with 7in. giant pneumatic tires. This vehicle is capable of maintaining a speed of 20 miles an hour on good roads, and provided the axle load does not exceed 2¼ tons the vehicle can put up a surprising cross-country performance. With these large pneumatic tires, the damage to roads is very slight, even if the foundations are thin. The pneumatic tires cost more than solid tires initially, but there is a considerable reduction in the wear and tear on the vehicle itself.

The Supply of Engineering Stores.

No one will deny the importance of an efficient stores organisation in connection with engineering work, and the supply of engineering stores was a question of considerable importance during the war. The average monthly supply of formations in France was 110,000 tons, and the value of these stores was about £2,200,000. Of these stores more than one-half consisted of raw timber which was nearly all obtained by the Directorate of Forestry from French forests. One-third of these stores were imported from home. The provision of all possible raw material from the theatre of war was, of course, very necessary to ease the strain on transportation; the supply of engineering stores from home was nearly all in the form of manufactured articles which could not be obtained in France.

As an instance of the work in the other theatres of war may be mentioned the greatest water supply scheme ever known in the annals of war—the laying of the pipe line from Egypt into Palestine. The entire success of the operations against the Turkish Army in the Isthmus of Suez depended on this. A project for carrying the water across the isthmus from Kantara, on the canal, to El Arish, on the Palestine frontier, was worked out by the engineering authorities in Egypt. The distance was some 90 miles: the quantity required daily was 600,000 gallons. It was proposed in this scheme that there should be four relays of pumping stations, with reservoirs, in the total distance of 90 miles, and that 60 miles of 12in. piping and 30 miles of 10in., as well as certain engines, pumps and machinery for the reservoirs, &c., would be required. This was the scheme worked out on the spot and cabled to the War Office.

The business of the War Office was to find the materials, namely, pipes, pumps, &c. The contract for pipes was placed in America, for no firm in England could produce what was required at such short notice. The War Office sent an expert to America to see the contract through, and to accompany the pipes to Egypt.

The Royal Navy specially escorted the ships bringing the piping. The Cairo Waterworks Company designed the filter plant, introduced new fool-proof devices, and installed the plant. The Suez Canal Company laid pipe syphons across the canal from west to east, this work entailing various diving and dredging operations. The military engineers of the force built the engine-houses, settling tanks, &c., on the east bank of the canal, and—most difficult task of all, perhaps—laid the pipes. The total weight of pumping machinery and stores transported from overseas was over 10,000 tons. Special arrangements had to be made at Kantara to receive this; sorting yards, workshops, &c., had to be constructed, and a wharf built of sufficient size to berth the ocean-going steamers which brought the materials. Finally, the War Office was asked to find and send out the best available expert on waterworks engineering to act as adviser and critic. He was found and went out accordingly and pronounced it all very good.

The scheme was initiated in July, 1916, and the Nile water flowed into Palestine in February, 1917. In spite of certain minor mistakes and failures, this was a wonderful feat, and it was made possible by the co-operation of many active and capable brains.

A point that must not be lost sight of in the question of the supply of engineer stores is to ensure that the cost of administration is kept as low as possible. In this direction the engineers employed in this branch showed that they were as successful in administration as they were over technical questions, for the work of administration only cost 0.66d. per £1 of stores supplied.

The Repair of Munitions of War in the Field.

This work was carried out during the war by the Royal Army Ordnance Corps, the Royal Army Service Corps and the Royal Tank Corps. Having described the work done by the various services and the progress made in workshop equipment, and the supply of spare parts, including the process of repairing worn components by electro-deposition, the lecturer summed up his remarks as follows:—Our conclusions as regards repair and maintenance in the field can be briefly stated as follows, and a distinct line can be drawn between repair and maintenance of munitions of war in the field. Just as the officers and men of a mounted unit are responsible that their horses are maintained in a fit condition, so the officers and men of any unit are now responsible for maintaining their guns, tanks, or whatever munition it may be, in an efficient state. This maintenance is carried out by periodical adjustments, oiling, greasing, &c., and the replacement of damaged parts where necessary. But just as a veterinary officer is attached to assist mounted units, so a mechanical engineer is required to help these units. He does not normally carry out any actual work, but is constantly testing and giving advice.

Under the heading of repair comes any work which cannot be carried out in the unit. For instance, when a tank or a gun is very badly worn or has been struck by a shell, it is inspected by the technical officer concerned and sent back for repair. In some cases, where the situation permits, the fighting *personnel* return with the tank or gun, or whatever munition is concerned, and assist in the repair work at the workshop. In this way they gain considerable experience which helps them in their work of maintenance.

In so far as a continental war is concerned, there will be very little in the way of workshops in the forward area; light workshops for dealing with the smaller repairs will be required in the corps areas, and heavier workshops in rear for the bulk of the work. In small wars abroad, however, where the units become very much scattered, it is possible that mobile workshops may have to accompany the units themselves.

Success in the mechanical maintenance of munitions of war in the field depends very largely on an efficient supply of spare parts, and every effort will have to be made in the next war to establish a system whereby a satisfactory supply is provided at the earliest possible moment.

As regards the mechanical education of the fighting *personnel*, the more knowledge they possess the easier will it be for them to carry out their mechanical maintenance. There is, however, not the slightest necessity for them to be mechanical engineers any more than the mounted soldier has the knowledge of the veterinary officer. The experience of the Tank Corps showed that a man with no previous knowledge could efficiently maintain his tank after a short course of instruction, and the lesson applies equally to all mechanical arms.

During the evening the lecturer showed some interesting lantern slides depicting the most recent tank and transport and bridging developments.

BOOKS RECEIVED.

Fuel Economy. By C. F. Wade. London: Chapman and Hall, Limited, 11, Henrietta-street, Strand, W.C. 2. Price 9s. 6d. net.

The Electric Supply Share Handbook. Compiled by Hubert Blake. London: Effingham Wilson, 16, Copthall-avenue, E.C. 2. Price 5s. net.

The Gyroscope: Practical Construction and Application. By P. Schilovsky. London: E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1. Price 14s. net.

"Mechanical World" Electrical Pocket-book, 1924. Manchester: Emmot and Co., 65, King-street, London: 20, Bedford-street, W.C. 2. Price 1s. 6d. net.

Marine Boiler Management and Construction. By C. E. Stromeyer. Sixth Edition. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 21s. net.

U.S. Department of the Interior, Bureau of Mines: Manual for Oil and Gas Operations. By T. E. Swigart and C. E. Beecher. Government Printing Office, Washington, U.S.A.

U.S. Department of the Interior, Bureau of Mines: Bibliography of Petroleum and Allied Substances, 1921. By E. H. Burroughs. Government Printing Office, Washington, U.S.A.

"The Practical Engineer" Mechanical Pocket-book and Diary, 1924. Edited by Ernest G. Beck. London: Henry Frowde and Hodder and Stoughton, 1, Bedford-street, Strand, W.C. 2. Price 2s. 6d. net.

Punjab Irrigation Branch Papers. Class A, No. 27. "Further Notes on the Sale of Water for Irrigation at Volumetric Rates." Lahore: Printed by the Superintendent of Government Printing, Punjab, 1923.

Acoustics of Buildings, Including Acoustics of Auditoriums and Soundproofing of Rooms. By F. R. Watson. London: Chapman and Hall, Limited, 11, Henrietta-street, Covent-garden, W.C. 2. Price 15s. net.

"The Practical Engineer" Electrical Pocket-book and Diary, 1924. Edited by Conrad Arnold. London: Henry Frowde and Hodder and Stoughton, Limited, 1, Bedford-street, Strand, W.C. 2. Price 2s. 6d. net.

The Engineering Association of Malaya.

WE recently received a copy of Vol. II. of the "Transactions" of the Engineering Association of Malaya, which deals with the doings of this active little society during the 1922 session. It will be remembered that we dealt with Vol. I. in the early part of last year, when we detailed the circumstances under which the body came into existence. From the volume now to hand we learn that, during the period which it covers, the following meetings were held and visits paid :—

February 26th: Annual general meeting at Kuala Lumpur;
July 15th and 16th: Meeting at Ipoh, visits to the Gopeng Mines and Spillway, Malayan Potteries, and Pengkalen Power Station;
September 16th and 17th: Meeting at Kuala Lumpur, three papers on "Roads";
November 18th: Extraordinary general meeting at Kuala Lumpur;
December 2nd and 3rd: Meeting at Johore Bahru and Singapore, visits to the Johore Causeway, Pulau Ubin Quarry, and the Admiralty oil fuel installation.

At the meeting in July the following papers were presented :—

"The Pipe Line and Workings at Gopeng Consolidated, Limited," by Mr. A. G. Glenister, A. Inst. M.M., and "Description of Pengkalen, Limited, Power Station and Electric Bucket Dredge," by Mr. W. J. Wayte, M.I.E.E. At the September meeting at Kuala Lumpur the titles and authors of the three papers were as follows :—"Notes on Road Location," by Mr. A. B. Potts, Assoc. M. Inst. C.E.; "Road Construction in the Tropics," by Lieut.-Colonel J. P. Swettenham; and "Road Maintenance in the Malay Peninsula," by Mr. E. L. Bennett, Assoc. M. Inst. C.E. For the meeting at Johore and Singapore in December the following papers had been prepared :—"Johore Causeway," by Mr. D. Paterson, Assoc. M. Inst. C.E., and "Pulau Ubin Quarry," by Mr. F. L. Williams, Assoc. M. Inst. C.E. Some of these papers, especially those on "Roads," elicited excellent discussions.

At the end of December, 1922, the membership totalled 172, which was made up of 9 honorary members—all elected during the year—157 members, and 6 associates. The names of the honorary members were :—Mr. R. O. M. Anderson, Assoc. M. Inst. C.E., Mr. L. M. Bell, M. Inst. C.E., Mr. F. St. G. Caulfield, M. Inst. C.E., Mr. H Gittins, Mr. H. H. G. Mitchell, M. Inst. C.E., Sir John R. Nicholson, M. Inst. C.E., Mr. R. Pierce, M. Inst. C.E., Mr. J. Trump, M. Inst. C.E., and Mr. M. F-G. Wilson, M. Inst. C.E.

The officers for the year 1923 were as follows :—President, Mr. J. Brown, M. Inst. C.E.; Vice-presidents, the Hon. J. H. W. Park, M. Inst. C.E., Mr. J. Strachan, M. Inst. C.E., and Mr. G. C. Forbes, M.I. Mech. E. Council :—Mr. H. R. Adams, M. Inst. C.E., Mr. P. A. Anthony, M. Inst. C.E., Mr. E. L. Bennett, Assoc. M. Inst. C.E., Mr. D. Paterson, Assoc. M. Inst. C.E., Mr. H. Robinson, Mr. J. P. Swettenham, Mr. W. A. Wilkinson, Mr. S. G. Williams, M. Inst. C.E., and Mr. W. J. Williams, M.I.E.E. Honorary librarian, Mr. F. G. Coales, Assoc. M. Inst. C.E.; honorary secretary, Mr. D. W. Brisbane, Assoc. M. Inst. C.E.

World Power Conference.

As previously announced—see our issue of October 12th last—the first World Power Conference is to be held at the British Empire Exhibition at Wembley from June 30th to July 12th next. It has been promoted by the Council of the British Electrical and Allied Manufacturers' Association (Inc.), in co-operation with technical and scientific institutions and industrial organisations in Great Britain and other countries, and will be under the presidency of the Earl of Derby, K.G.

The following is a list of countries which have, up to the present, signified their intention of participating in the Conference :—Australian Commonwealth, Austria, Belgium, Dominion of Canada, Czecho-Slovakia, Denmark, Finland, France, Great Britain, Greece, Holland, Indian Empire, Italy, Norway, Poland, Roumania, Russia, Spain, Sweden, Switzerland, and the United States of America.

LIST OF SECTIONS.

DIVISION I.: POWER RESOURCES.

Section A.—Power Resources, National Reviews: General Survey, Power Resources, Available and Utilised, Administration, Power Requirements.

DIVISION II.: POWER PRODUCTION.

Section B.—Water Power Production.
Section C.—Preparation of Fuels: Distillation of Coal, Pulverised Coal, Distillation of Shales, Oil Refining, Lignites, Peat.
Section D 1.—Steam Generation: Boilers, Utilisation of Fuels, Waste Heat.
Section D 2.—Steam Turbines.
Section E 1.—Internal Combustion Engines, Crude Oil.
Section E 2.—Internal Combustion Engines, Gas, Oil and Spirit.

DIVISION III.: POWER TRANSMISSION AND DISTRIBUTION.

Section G 1.—Alternating-current Transmission and Distribution: Generators, Motors, Transformers and Switchgear, Transmission Lines, Underground Cables.
Section G 2.—High-voltage Direct-current Generation, Transmission and Distribution.

DIVISION IV.: POWER UTILISATION.

Section H: Power in Industry and Domestic Use.
Section J.—Electro-chemistry and Electro-metallurgy.
Section K 1.—Power for Land Transport.
Section K 2.—Power for Water Transport.
Section K 3.—Power for Air Transport.
Section L.—Illumination.

DIVISION V.: GENERAL.

Section M.—Economic, Financial and Legal Aspects of Power.
Section N 2.—Standardisation.
Section N 3.—Education.
Section N 4.—Health.
Section N 5.—Publicity.
Section N 6.—British Empire Resources.

The following preliminary announcement as to conditions and privileges of membership has just been made public :

Ordinary Members.—Any applicant, subject to the approval of the Executive Committee, is entitled to become a member of the World Power Conference on payment of the sum of £2, which will be used towards defraying the stenographic and other expenses incident to the conduct of the Conference. Members will receive a membership ticket, which will entitle them to free admission to the British Empire Exhibition and the Conference Halls during the period of the Conference. These tickets will be personal and not transferable. Members, if they desire it, can purchase, at a nominal price, copies of papers in the sections in which they are interested, the charges for which will be announced at a later date. These copies will be available for members only. Papers will be on sale at the hall, but members who wish to take part in the discussions should apply in advance for such papers as they may require.

Official Delegates.—The official delegates appointed by the participating National Committees are entitled to free membership. Copies of the papers for presentation at the Conference will be sent free to official delegates in advance of the Conference, through their respective National Committees.

International Executive Committee.—It is proposed that an International Executive Committee shall be formed immediately prior to the Conference, on which each participating National Committee will be represented. The Committee will meet periodically at convenient times throughout the Conference, in order that the Conference may be conducted in a mutually satisfactory manner. It is proposed that the Committee shall be responsible for the reception, preliminary consideration and ultimate promulgation of any resolutions passed at the Conference.

Official Receptions and Social Functions.—A special Committee has been formed to arrange official receptions and social functions, and announcements will be made at a later date.

Official Tours After the Conference.—Official tours, in which Members are invited to join, are now being arranged to follow the Conference. These tours, of which particulars will be issued later, will include visits to :—(1) Places of interest and works in Great Britain; (2) places of interest, hydro-electric stations, &c., in Sweden and Norway; (3) places of interest, hydro-electric stations, &c., in France, Italy and Switzerland.

All communications and applications for membership should be addressed to the secretary, World Power Conference, 36, Kingsway, London, W.C. 2.

RAILWAY-TIRE BORING MACHINE

CRAVEN BROTHERS (MANCHESTER), LTD., REDDISH, ENGINEERS

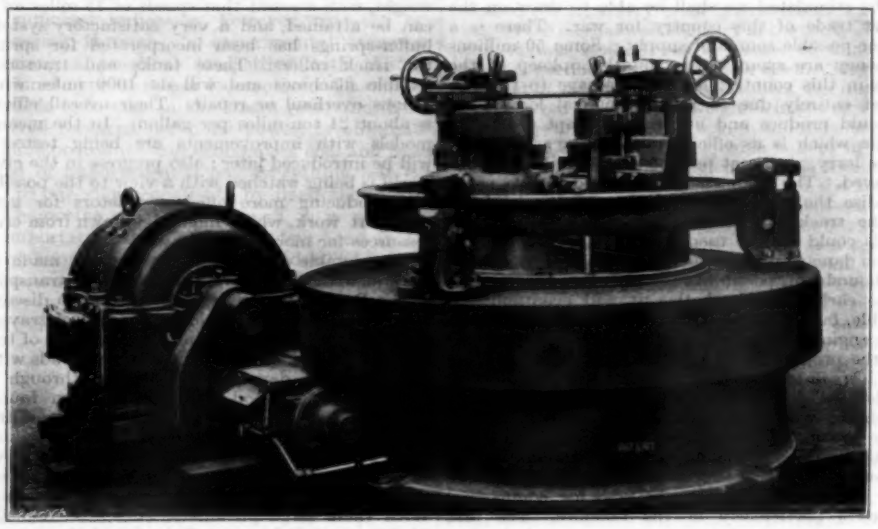


FIG. 1

New Tire-Boring Machine.

THE accompanying engravings represent a new type of machine for boring and recessing locomotive, carriage and wagon tires, which has been produced by Craven Bros. (Manchester), Limited, Reddish, near Stockport. These machines are made in several sizes to take tires varying from 3ft. 1in. to 7ft. in diameter, and can be arranged to be driven either by belt or electric motor. The actual machine illustrated has been built for tires 5ft. in diameter, and is driven by a variable speed motor with a three-to-one speed range, which is mounted on a base-plate attached to a planed facing on the body of the machine, and which is connected to the worm driving shaft by single-purchase spur gearing. The drive is effected by means of a worm and worm wheel running in an oil tank, the worm wheel being keyed to a vertical shaft fitted with a pinion engaging with an internal spur wheel on the revolving table.

The body of the machine is of circular form, and is stiffened by means of ribs. It has an annular turned surface, with a centre pivot for the reception of the

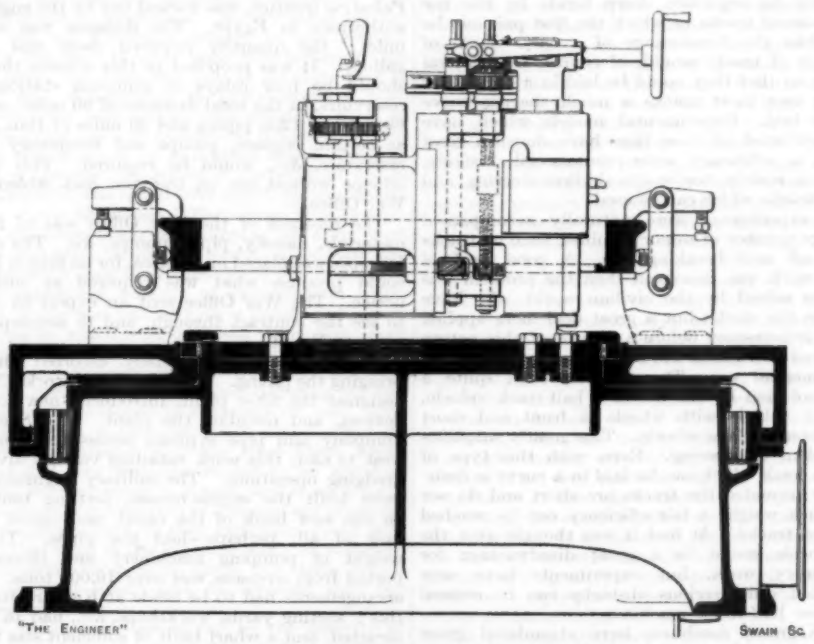


FIG. 2—SECTION THROUGH TIRE-BORING MACHINE

revolving ring or table, which carries the tire to be operated upon. The upper centre part of the body is machined to receive two compound slide rests, placed face to face and designed and arranged so as to occupy only the space inside the tire, while leaving ample space for lifting the work into and out of the machine. The tool slides have variable self-acting horizontal and vertical traverses with hand adjustment in both directions, and the rate of feed can be altered whilst the machine is running. The automatic feed motion provides for five changes

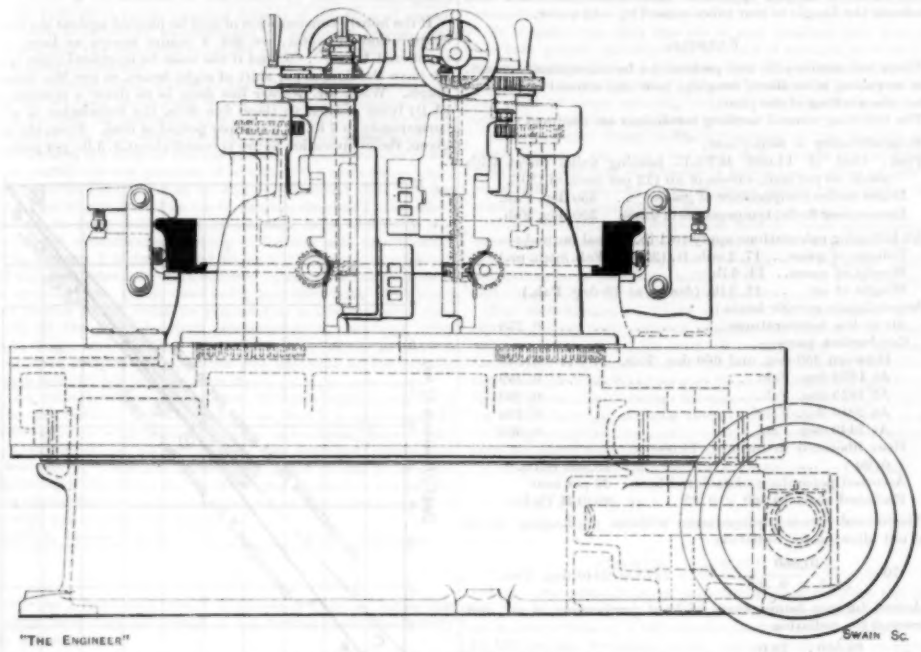


FIG. 3—SIDE VIEW OF TIRE-BORING MACHINE

of feed in both directions by means of discs and a ratchet wheel. Hand adjustment is effected by hand wheels, which are readily removable when the tire is being lifted or lowered. Adjustable stops are provided to regulate the internal diameter of the tires, and graduated discs are fitted to enable the operator to gauge the various operations.

Duplicate tool boxes are provided and are readily removable from the tool slides, so that whilst one set of tools is cutting, the other set can be re-ground and made ready for use. For tires fitted with Mansell rings,

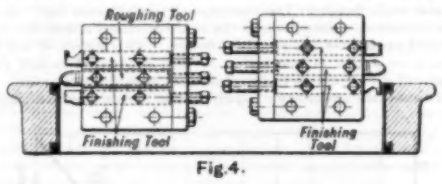


Fig.4.

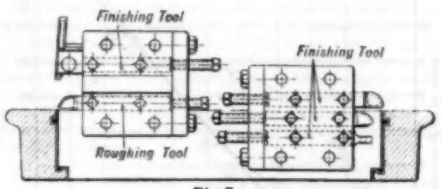


Fig.5.

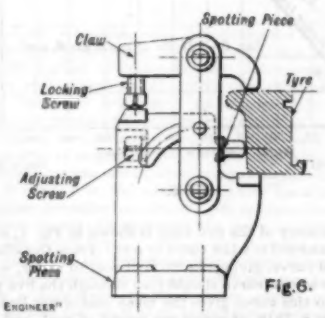


Fig.6.

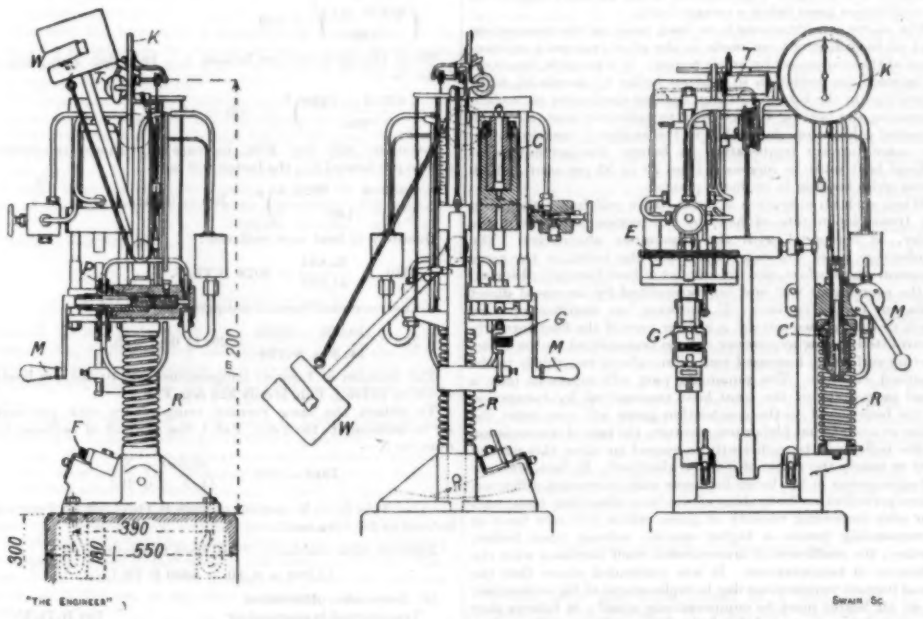
FIGS. 4 TO 6—CUTTING TOOLS AND GRIPPING DOG

two sets of gang cutters are employed, three tools in each set, as shown in Fig. 4. One set comprises one rough boring tool, one tool for cutting out the recess, and a third tool for finishing the groove. The other set has one finish boring tool, one tool for cutting out the recess, and a third for finishing the groove. When boring, after the roughing tool has begun cutting, the finished boring tool follows it up, so that with two tools cutting, the tire is finish bored on one traverse. When the recess has been cut on both sides, the grooving tool starts cutting on the opposite side, so that practically two tools are cutting all the time. For tires fitted with Gibson rings, as shown in Fig. 5, the arrangement of the cutters is different. Two sets of gang cutters are employed again, but there are three tools in one set and only two in the other. The three tools comprise two finish boring tools for the two internal diameters, and a third tool for cutting out and finishing the side groove. The other box contains one tool for rough boring the internal diameter, and one for cutting out and finishing the bottom groove. The roughing tool is followed by the finishing tool, so that the internal diameters are bored at one traverse through, after which the grooves are cut out and finished simultaneously.

The table on which the tires are mounted revolves on a circular flat face, as shown in the sectional drawing, with a centre pivot to keep the table concentric. There are two adjustable pads for taking up the wear, and the horizontal and vertical sliding surfaces are grooved to receive the lubricant. The tire is held in position by three or four specially designed gripping dogs—according to the diameter—of which a detailed drawing is given in Fig. 6. The dogs are each provided with a spotting piece for setting to circular lines on the table, and the tires are set from a second spotting piece on the inside of the dogs. Adjusting screws are provided for centralising the tire, and the claw is locked on to the tire by means of a locking screw. When the latter is released the claw can be thrown back for the removal of the tire.

As previously stated, the worm and worm wheel revolve in an oil tank. In this tank an immersed plunger pump is situated, the reciprocating motion being obtained by means of an excentric disc on the worm wheel. The pump forces the oil through the lubricating pipes to the table slides and the centre pivot, and the spent oil passes through a gauze sieve back into the tank. In this way a continuous flow of lubricant is provided. The worm shaft is fitted with three self-lubricating ring oil bearings and a ball thrust washer to take the end pressure.

The machines are also made as twin boring mills, in which case two machines are bolted together, and can be operated by one attendant.



MACHINE FOR TESTING AERONAUTICAL WOODS

Manchester Association of Engineers.

SOME NEW DYNAMOMETERS.

A PAPER, entitled "Some New Dynamometers," was read by Mr. J. S. Glen Primrose at a meeting of this Manchester society on Friday, 25th ult. In his paper the author reviewed some of the more modern methods in use for measuring variable forces and contrasted them with some of the older forms. He divided dynamometer instruments into two main classes, one for measuring static forces, which are either constant and do not vary in their point of application, or are variable both in magnitude and position or direction; and the second for dealing with a dynamic force, the application of which is very rapid and does not readily lend itself to being balanced. The subject was subdivided under the following headings:—The pressure gauge, the simple lever, the pendulum dynamometer, spring dynamometer, torsion dynamometer, transmission dynamometer with autographic attachment, traction dynamometers, impact dynamometers, and tup dynamometers with oil transmission. Perhaps the least known instrument which the author described is an interesting adaptation of the pendulum dynamometer, which has recently been introduced at the French Military Aviation Laboratory at Chalis Mendon, for the testing of woods used in aeroplane construction. In this apparatus, both static and dynamic tests can be carried out and the loading is effected by a hand-operated screw pump. The general arrangement of this appliance is shown in the accompanying engravings. The two uprights of the frame are rigidly secured to a pedestal, and are connected at the top by a cross piece, which carries the load dial and diagram recording mechanism. The right-hand column carries the pump P and the spring dynamometer R, which actuates the pointer over the load dial K. The left-hand column supports the cylinder C of the oil press, which is provided with two frictionless rams. Both of the rams together can apply a force of 4 tons, but when the outer ram is locked by a catch the inner ram can only attain one-tenth of this load. Resting on the rams is a short stirrup, which suspends the various grips for performing the tension, compression, bending, splitting, shearing and hardness tests. In pipe line connection with the press cylinder C is a pressure-reducing cylinder C^1, and as the pressure rises a steel piston is expelled and forces down the cap used to compress the measuring spring, the lower end of which butts on the pedestal. As the spring distends, it moves a thread wound round the grooved pulley of the load dial pointer, and makes the needle indicate the force being balanced by the spring. When the test piece fails, the by-pass valve allows the oil to escape slowly from the small cylinder, so that the pointer drops back slowly to zero, leaving the loose pointer to indicate the maximum attained. For the transverse shock tests, the pendulum bob shown is lifted by hand until the rod is engaged by a hook. When released, it swings down and breaks the wood test piece, and rises up on the other side. In doing so, it engages a pointer which moves up a vertical scale and records the total energy absorbed by the fracture. A rope brake prevents the re-descent of the pendulum until the counterpoise weight is lifted by hand. One of the bar supports is fixed, but the other is hinged so that it rests by the intermediary of a 1 cm. sphere against a bar of soft aluminium. When the pendulum hammer strikes the bar, part of the energy is absorbed in pressure on the supports, and this causes the ball to penetrate the aluminium. From the size of imprint thus made and the known hardness of the aluminium, there can be deduced the maximum pressure supported by the broken bar. This device, invented by Breuil, is known by the fanciful name of the "crocodile support." The pedestal of the machine which takes the shock of the falling pendulum hammer weighs about 200 lb., and the maximum capacity of the impact hammer is 70 foot-pounds.

THE new cotton ginnery at Salisbury, Rhodesia, is to be opened within the next few weeks.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AIR HEATERS.

SIR,—Being under the impression that the increasing use of air heaters in steam raising installations makes it necessary to appreciate fully the nature of the changes produced in the working of a boiler plant, I shall feel obliged if you will permit me to put my views on this subject before your readers.

The fundamental question arising with regard to air heaters in coal-burning plants may be formulated as follows:—Is it possible and practicable to replace the economiser in a given boiler plant by an air heater without making any other modifications in the boiler arrangement, whilst maintaining the same evaporation and efficiency? To answer this question, it is necessary to inquire how the heat balance and working *régime* of the unit will be affected by such a change. For the purpose of such an investigation, no noticeable error will be made in assuming that all minor heat losses, as loss owing to incomplete combustion, loss of combustible in the ashpit and ash hopper, loss in soot carried away and loss of outside radiation from brickwork and other exposed parts, will remain unchanged.

The maintenance of an unaltered efficiency means an unchanged loss in waste gases, and consequently the same amount of heat will have to be absorbed now in the boiler alone which has been absorbed in boiler and economiser in the original installation. The heat absorbed in the air heater does not affect the heat balance, as apart from negligible losses incurred in every heat transfer from higher to lower level the same amount of heat is returned through the heated air into the furnace.

The first and most obvious effect of introducing heated air into the furnace will be a rise of the furnace temperature. Great attention has been given to this side of the question by many authorities, and it has been made an important argument against the use of air heaters on the presumption that an increase of furnace temperature will have a most detrimental effect on the furnace brickwork. There are, however, no reports published till now about cases where the application of pre-heated air caused brickwork troubles not experienced before, and closer consideration shows that there are circumstances tending to lower the rise of furnace temperature expected. First, the weight of combustion gases is always some 6 to 10 per cent. higher than the weight of air blown under the grate; secondly, the specific heat of combustion gases at furnace temperatures is about 25 per cent. higher than the specific heat of air at the relatively low temperature it acquires in the heater; thirdly, and this is the most important factor, the quantity of heat transmitted by direct radiation from the fuel bed to the heating surface increases very quickly with the rise of furnace temperature. As a result, the rise of furnace temperature can only be a fraction of the rise of air temperature in the heater. Actual practice confirms this. During tests in Sweden with Thermix heaters—see *Engineering*, June 29th, 1923—the increase of furnace temperature was about 48 per cent. of the increase of air temperature. Münzinger—"Amerikanische und Deutsche Grossdampfkessel," Berlin, 1923—who was one of the first to draw attention to some of the above points, states that in a properly designed plant this ratio will be 30 per cent., which is well confirmed by attached brief approximate calculation.

It is further necessary to bear in mind that the possible rise of air temperature in air heaters of properly designed plants is limited in view of the fact that the ratio of weights of combustion gases and air passing the heater in opposite directions is in all practical cases not far from 1, and even in induced draught plants it will not prove economical to reduce the temperature of combustion gases below a certain limit.

The above considerations have been made on the assumption that no modifications are made in the plant, except a replacement of the economiser by an air heater. It is possible, however, to increase the radiation in a given boiler by means of slight alterations in the furnace setting, such as shortening of arches, increasing the heating surface open to radiating heat, &c. The attached calculation shows that in the analysed case, to obtain the same furnace temperature as before, the percentage of radiant heat must be increased from 29 to 33 per cent., which seems quite feasible in ordinary plants.

When such an alteration is made, there will be no change in the transmission rate of heat by convection throughout the boiler, as compared with the economiser alternative. The combustion gases will enter and leave the boiler at the same temperature as before, and the amount of heat formerly absorbed in the economiser will now be transmitted by increased direct radiation in the furnace. If, however, no modifications are made to the furnace setting, a greater part of the heat formerly transmitted in the economiser will be transmitted to the boiler heating surface by increased radiation—about two-thirds in the analysed example. The remaining part will represent only a small percentage of the total heat transmitted by convection in the boiler, and as the combustion gases will now enter the boiler at a somewhat higher temperature, the rate of transmission in the boiler will be sufficiently increased to allow this part of heat or nearly the whole of it to be absorbed. In fact, the rate of transmission in the boiler increases with increasing difference of temperatures on both sides of the heat-absorbing body, and also with increasing velocity of gases, which will now have at corresponding points a higher specific volume than before. Further, the coefficient of transmission itself increases with the difference of temperatures. It was contended above that the rise of furnace temperature due to replacement of the economiser by an air heater must be comparatively small; it follows that the rise of temperature behind the boiler will be still smaller, and in the analysed example can be estimated not to exceed 20 deg. to 30 deg. Fah. Münzinger confirms this conclusion, stating that in order to obtain the same efficiency, all other conditions remaining unaltered, the air heater ought to absorb only about 12½ per cent. more heat than was previously transmitted in the economiser.

The above considerations can, on the whole, be also applied to cases where air heaters are to be added to existing boilers working without economisers. In this case, however, the rise of furnace temperature will be still lower than in the first case. As an air heater means increased efficiency of the plant, less coal will be consumed for a given evaporation, and it is well known that a lower rate of fuel burned on the grate means a lower furnace temperature.

It is not the purpose here to enumerate all the already fairly known advantages of air heaters. The following can be said, however, with regard to two of the most common objections:—

(1) There is no conclusive evidence that the rate of heat transmission in the air heater is, under equal conditions, lower than the rate in the economisers. American practice with indirect heaters for buildings (*Power*, November 20th, 1921) shows that the rate in air heaters is anywhere between 4 to 10 B.Th.U. Continental authorities, too, are not inclined to believe that for equal duties the heating surface of air heater ought to be larger than the economiser heating surface. With equal heating surfaces, however, an air heater will certainly require less space, have less weight, and cost less than an economiser.

(2) In most properly designed plants there is enough waste heat available, besides combustion gases, to pre-heat the feed water in much simpler apparatus than economisers and thus eliminate the danger to rear tubes caused by cold water.

EXAMPLE.

These calculations do not pretend to be scientifically exact. The intention is to show, roughly, how the altered conditions affect the working of the plant.

The following normal working conditions are assumed:—

Total efficiency = 80 per cent.

Fuel: Coal of 11,000 B.Th.U. heating value burnt with about 60 per cent. excess of air (12 per cent. of CO_2).

Boiler outlet temperature of gases .. 550 deg. Fah.

Economiser outlet temperature of gases 350 deg. Fah.

All following calculations apply to 1 lb. of coal burned:—

Volume of gases .. 17.2 cub. ft. (32 deg. Fah./atm. pr.)

Weight of gases .. 14.5 lb.

Weight of air .. 13.5 lb. (drawn at 70 deg. Fah.)

Approximate specific heats:

Air at low temperatures	0.238
Combustion gases—	
Between 350 deg. and 660 deg. Fah.	0.249
At 1830 deg. Fah.	0.289
At 1925 deg. Fah.	0.292
At 2010 deg. Fah.	0.295
At 2440 deg. Fah.	0.307
Heat liberated in furnace, 11,000 × 0.96	10,560 B.Th.U.
Assumed percentage of radiated heat	25 per cent.
Radiated heat, 10,560 × 0.25	2640 B.Th.U.

Theoretical furnace temperature without pre-heating of air and not allowing for radiation:

$$70 + \frac{10{,}560}{14.5 \times 0.307} = 70 + 2370 = 2440 \text{ deg. Fah.}$$

Actual furnace temperature without pre-heating of air, but corrected for radiation:

$$70 + \frac{10{,}560 - 2640}{14.5 \times 0.292} = 70 + 1870 = 1940 \text{ deg. Fah.}$$

Economiser Replaced by Air Heater.—Allowance must be made for the higher temperature of gases at boiler outlet due to rise of furnace temperature. Basing on Münzinger, it is assumed that the drop of gas temperature through the air heater will be 12½ per cent. more than the corresponding temperature drop through the economiser, and will be equal to 200 × 1.125 = 225 deg. Fah., which means that the gases will now leave the boiler at 575 deg. Fah.

Rise of air temperature in heater:

$$\frac{225 \times 14.5 \times 0.249}{13.5 \times 0.238} = 253 \text{ deg. Fah.}$$

Theoretical rise of furnace temperature, not allowing for radiation:

$$\frac{225 \times 0.249}{0.292} = 192 \text{ deg. Fah.}$$

The quantity of radiated heat is proportional to the factor

$$\left(\frac{459.4 + t}{180}\right)^4 - 500.$$

When the air is not pre-heated, t = 1940 deg. Fah., and the factor is—

$$\left(\frac{459.4 + 1940}{180}\right)^4 - 500 = 31{,}075.$$

Assuming 82½ deg. Fah. increase of furnace temperature due to pre-heated air, the factor will be:

$$\left(\frac{459.4 + 2022.5}{180}\right)^4 - 500 = 35{,}644.$$

Quantity of heat now radiated:

$$2640 \times \frac{35{,}644}{31{,}075} = 3028 \text{ B.Th.U.}$$

Actual corrected furnace temperature—

$$262 + \frac{10{,}560 - 3028}{14.5 \times 0.295} = 2022\tfrac{1}{2} \text{ deg. Fah.}$$

The increase of furnace temperature due to the pre-heating of air by 253 deg. Fah. is only 82½ deg. Fah.

To obtain the same furnace temperature with pre-heated air as without it (1940 deg. Fah.), the amount of radiated heat must be X—

$$1940 = 262 + \frac{10{,}560 - X}{14.5 \times 0.292}$$

X = 3455 B.Th.U. instead of 3028 B.Th.U., or 32.7 per cent. instead of 28.7 per cent.

Effect on Heat Balance.—Total heat transmitted—

$$11{,}000 \times 0.80 = 8800 \text{ B.Th.U.}$$

(1) *Economiser Alternative.*

Transmitted in economiser	722 B.Th.U.
Transmitted in boiler by radiation	2640 B.Th.U.
Transmitted in boiler by convection	5438 B.Th.U.

(2) *Air Heater Alternative.*—(a) Furnace setting not altered.

Transmitted in boiler by radiation	3028 B.Th.U.
Transmitted in boiler by convection	5772 B.Th.U.

or only 6.2 per cent. more.

(*b*) Furnace setting altered to increase radiation and obtain same furnace temperature as before—

Transmitted in boiler by radiation	3455 B.Th.U.
Transmitted in boiler by convection	5345 B.Th.U.

GEORGE HENRY.

POWDERED FUEL.

SIR,—In reply to Mr. Napier's letter in your issue of January 25th, my graph of the Lakeside station is based on figures given on page 20, Table VIII., of the advanced proof of Mr. Brownlie's paper "Pulverised Fuel and Efficient Steam Generation." The figures are as follows:—

Test No.	1.	2.	3.	4.	5.
Total fuel fired, lb.	253,161	233,477	190,334	160,881	274,640
Fuel fired hourly, lb.	5,980	9,740	9,560	6,580	11,350
Total water fed to boiler, lb.	2,260,018	2,012,452	1,615,330	1,393,250	2,228,514
Water fed to boiler per hour, lb.	53,390	83,933	81,121	57,572	92,202
Water evaporated per lb. coal, lb.	8.93	8.62	8.49	8.66	8.12

If the hourly consumption of coal be plotted against the hourly evaporation of water, we get 5 points shown as large dots, numbered 1 . . . 5, and if the scale be increased eight times, we have the figures per shift of eight hours, as per Mr. Napier's graph. What Mr. Napier has done is to draw a straight line (A B) lying nearest to these five dots, the inclination of which corresponds to 7 lb. of water per pound of coal. From the table given, the evaporation figure is round about 8.5 lb. per pound of

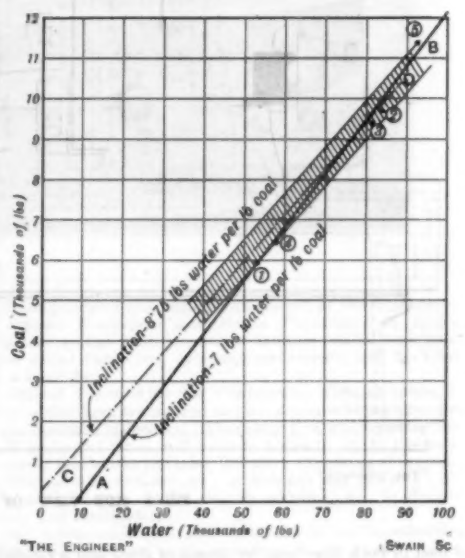


FIG 1.

coal—the mean figure taken from the plotted results is 8.75 lb. of water per pound of coal. Clearly, then, the inclination of Mr. Napier's Lakeside curve is wrong. The true Lakeside "Parson curve" is obtained by placing a line C D, corresponding to 8.75 lb. of water per pound of coal, between the five dots. A similar curve is obtained by plotting the total coal against total water, the figures of which are of the order of the Dalmarnock station, as per my letter of January 18th. But why this attempt to apply large power station characteristics to a few tests taken of one single boiler? The intercept of the "Parson line," with zero ordinate, corresponds to the coal consumed chiefly by the banked-up fires of the stand-by boilers. This source of loss is absent on a test of one boiler, so that one would expect the origin of a Parson line to be somewhere near the zero point.

To show the absurdity of applying the Parson line to a single

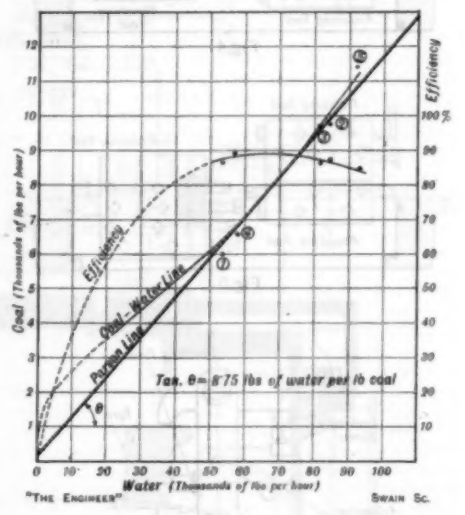


FIG 2.

boiler, the efficiency of the five tests is shown in Fig. 2, and the line carried backward in a fair curve to zero. From this efficiency curve a second curve, giving the ratio of coal to water, is easily derived. This second curve should pass through the five points. The tangent to this curve gives the mean coal-water line. The actual value is 8.75 lb. of water per pound of coal, and which confirms the mean line drawn in Fig. 1.

What happens at zero point is problematical, but the general lie of the curves rules out all the elaborate reasoning concerning the Lakeside boiler raising steam with no consumption of fuel.

NORMAN SWINDIN.

Acton, W. 3, January 29th.

MARINE HOT-BULB ENGINES.

SIR,—I have been very much interested to note the letter from your correspondent "Engineer-in-Chief," which appears in your issue of the 25th inst.

The troubles which he refers to with hot-bulb oil engines are

very well known among all makers and users of engines of this type, and your correspondent's remarks express very completely and concisely our own opinions in regard to the two-cycle enclosed crank case engine.

My firm have been makers of this type of engine for more than ten years, but it is a type which we do not like, and which we believe is now rapidly going out of favour. There seem to be fashions in oil engines such as there are in ladies' hats, and the manufacturer has to supply what fashion demands.

Although we have been making these engines for a considerable period and have ourselves been able to introduce a number of improvements which, at any rate, to a certain extent overcome some of the difficulties mentioned by your correspondent, we are fully alive to the inherent defects of this type of engine, and have consistently endeavoured to persuade engine users not to instal the two-cycle enclosed crank case engine whether for land or marine use.

Your correspondent wishes to know if any firm contemplates building an open crank case two or four-cycle oil engine, and I think he may be interested to learn that at the request of the Admiralty my firm designed and constructed engines of this type towards the close of the war period. This work was undertaken purely for the purpose of avoiding the difficulties which "Engineer-in-Chief" refers to and in the belief that an open crank case engine would go far to remove the disabilities which seem to be inseparable from all engines, both of British and continental manufacture working with crank case compression.

The engines I have referred to were built with cross heads and slipper guides, and were entirely open below the bottom of the cylinder, the crank case being provided with light sheet steel guards which could be removed in a few minutes, after which all the main bearings, connecting-rod bearings, cross heads, slides and stuffing boxes were quite easily accessible. A separate compression chamber was provided at the bottom of each cylinder but isolated from it.

I am strongly of the opinion that the open crank case engine is the only suitable type for marine use, but it is unfortunately handicapped to some extent by being unavoidably heavier and more expensive to construct than the enclosed crank case engine. It is, therefore, almost impossible to sell it in competition with the latter, but to those who appreciate the advantages offered by the open crank case engine, the extra cost would probably not prevent its adoption.

Halifax, January 30th. HUGH CAMPBELL.

SIR,—As I have only seen "Engineer-in-Chief's" letter this morning, time does not permit of my dealing more than briefly with the subject.

Your correspondent has had the courage to set down clearly and concisely the difficulties he has experienced over quite a long period with a considerable number of engines by various makers.

It must be a matter of common knowledge to both makers and users of these engines that the facts as he states them are, in the main correct, and that his indictment is a true one. The fact that many of these engines have run without trouble for considerable periods, and, like Charley's Aunt, are "still running," does not in any way weaken his argument that there is an inherent defect in the type which does, sooner or later, cause serious trouble. The extent of his experience proves his case.

I hope to have an opportunity of dealing adequately and fully with the subject in a later issue, but may now say that as the points mentioned in paragraphs 1—4 are a direct result of the troubles detailed in paragraph 5, and, as these arise from the fundamental principles of the crank case compression two-cycle engine, your correspondent's conclusion that crank case compression must be abandoned is absolutely right, and the only possible solution.

When this is done, most of the running troubles of the two-cycle engine, and the consequent ship delays and high maintenance cost, certainly do disappear. In this connection, however, much can be said for the adoption of the four-cycle heavy oil engine as against the two-cycle engine, quite apart from the acknowledged superiority of the former in the wide range of fuel oils it can use and its lower consumption.

Your correspondent blames the makers for cramping up the two-cycle engine, but the onus lies on the shipowner, who demands the cheapest engine he can get, and will not allow either the extra engine room or, still less, pay the extra price for the more perfect engine, although neither of these factors are in any way excessive. It is a short-sighted policy which we have deplored for a very long time, and although we sympathise with "Engineer-in-Chief" in his troubles, we welcome his confession, as it goes to the very root of the future success of marine oil engines of medium powers.

LEDGER COZENS, London Manager,
THE CAMPBELL GAS ENGINE COMPANY, LIMITED.
London, January 30th.

SIR,—Your correspondent, "Engineer-in-Chief," evidently has experienced the same troubles concerning small hot-bulb marine oil engines as I have myself. I frequently asked why designers still adhere to the crank case compression type of engine. The reply I generally get is that it is commercially impossible to produce the open type of engine or one embodying low propeller revolutions per minute. The fact remains that the open type of engine, or at least one employing other means of scavenging than crank case compression, must come; in fact, it is already on the market, and also has a reducing gear which gives propeller revolutions per minute about the same as a steam engine; furthermore, the price is slightly less than that of the closed type. There is also a closed type of engine on the market of the crosshead type, which compresses its air in a separate chamber and employs high-pressure lubrication the same as a high-speed enclosed steam engine or automobile engine, so that the chances of inadequate lubrication are rare. As regards "Engineer-in-Chief's" remarks re carbonisation of cylinders and lubricating oil consumption, if due care is taken to obtain the correct timing of the fuel pump and clean crank case air valves this trouble will be minimised; in fact, I once ran an engine for seven solid months regular trading on the London and North France trade, and then only drew the pistons to replace the top end bushes. This engine was a 4-cylinder 12 by 14 job at 280 revolutions per minute. As regards lubrication, apparently wear takes place regardless of the quantity used, but this can be reduced without any detrimental effect to the engine. My last ship was a 320 horse-power job with four cylinders running at 225 revolutions per minute. I never ran this engine past 180 revolutions per minute, and never had any trouble, whilst my lubricating oil consumption was just under a quart per hour at 3s. 2d. per gallon, and no excessive wear took place.

Cardiff, January 23rd. ANDREW MACFADGEN.

STAINLESS IRON AND STEEL.

SIR,—The leading article on "Chromium" in your edition of January 18th emphasises the importance of supplies of "stainless" iron and steel products being obtainable at a reasonable cost, and suggests that the high price is partly due to the "particularly refined and expensive form" in which chromium is introduced into the metal, and partly to commercial reasons.

It is quite true that the use of rust resisting iron and steel has been greatly restricted on account of its high price, but the recent introduction of a process for the direct reduction of chrome ore in steel-making furnaces has already greatly reduced the price of many articles, and will very shortly make many others available at reasonable prices.

Seven British firms, including several of the leading alloy steel makers, are now working this process under licence, with the result that stainless iron ingots can now be bought for about £30 per ton and 18 to 20 gauge sheets, suitable for deep stamping, for about £75 per ton.

Until recently, the latter were sold in small quantities for over two shillings a pound, so that it is obvious that the conditions which you described are now a thing of the past. Similar reductions have also been made in the cost of wire and strip, and cheap tubes will also shortly be obtainable.

The introduction of 12–14 per cent. of chromium will, of course, always keep the cost considerably higher than that of ordinary steel, the high cost of transporting the necessary chrome ore from such distant places as Rhodesia, Beluchistan and New Caledonia being an important factor in its price; but the figures given above make the use of this new alloy possible for numerous purposes, and within the next few months it will certainly compete successfully with brass and replace ordinary steel for many purposes.

STAINLESS IRON AND ALLOYS COMPANY, LIMITED,
W. S. GIFFORD.
London, January 25th.

PLANING MACHINE DRIVE.

SIR,—The tests given on page 102 of your issue for the 25th inst. recall to our minds some similar tests made here in 1905/06 on the conversion of a belt-driven planing machine, 6ft. by 6ft. by 14ft. stroke, to electric drive, when we found that, on similar work, we obtained twice the number of strokes—66 against 134—per hour, with the machine operating in each case as set by the workman, thus getting twice the output without any special prompting to obtain the best possible result.

The cutting speed was increased from 23ft. per minute to 57ft. per minute, and the return speed from 50ft. per minute to 58ft. per minute, it not being considered advisable then to increase the latter in view of the size of the machine.

Since that time we have made further alterations, and can now get variable cutting and return speeds from 25ft. to 70ft. per minute in either direction. As this machine is twenty-six years old it is a good example of the advantages of direct electric driving.

The length of the work cut was 12ft. 6in., and one great difference between the belt drive and the electric drive was in the reduction of the overrun at the end of each stroke. The total travel of the table when belt driven was found to be 14ft. and only 13ft. with electric drive.

A serious omission from the figures of the tests quoted in your paper is in respect of this question of "overrun" at end of cut. We found the electric drive enabled us to plane "to a line," whereas with the belt drive a considerable margin had to be allowed for variation in the slip of the belt, and no doubt your readers would like to know how the clutches named in your paper behave in this respect.

For comparison with the above the nearest figures in the tables published in your issue show that the cutting speed was increased from 34ft. to 38ft. per minute, and the return speed from 70ft. to 144ft. per minute and the cycles per hour from 108 to 140 on 12ft. stroke. This is no better than we were doing in 1906 on a much larger machine, and seems to show the great superiority of the direct electric drive over any system of clutches.

JOSEPH ADAMSON AND CO.
Cheshire, January 30th.

RAILWAY ELECTRIFICATION.

SIR,—I do not understand your suggestion that (to paraphrase) "Mr. Sayers having said that the use of the phases separately would be impossible, now agrees that the idea is not impossible, but opposes it on the ground of telephone interference."

The objection was, and is, the same in both of my letters. The scheme is, in my opinion, practically impossible.

You say also that I do not explain why inductive troubles have not outweighed the advantages of single-phase working in the limited amount of electrification of the Brighton Railway and on other important railways. This is a question for those respectively designing the various electrifications to answer.

The inter-relation between railway routes and main telephone and telegraph routes in this country differentiates it from most others, if not from all. A tour through the States will convince anyone, as it did me, of this fact as between the States and England.

With the greatest respect for Major A. M. Taylor, I must be excused from going into detailed examination of his letter. I can assure him that all the points he mentions have been well in mind for many years past by those interested in traction. Is Major Taylor's statement, that the generator of the Chicago, Milwaukee and St. Paul motor is a single machine, with 3000 volts across one commutator, correct? My remembrance is that they consist of two 1500-volt generators in series.

Derby, January 29th. F. SAYERS.

SIR,—With reference to the railway electrification controversy which has continued for so many years, I venture to suggest that the following point of view has been somewhat overlooked.

I think that most of the authorities agree that the final cost of transport is almost the same for either system. It, therefore, seems to me that it is more important to select one system definitely and stick to it, than to try to settle which is best. It seems possible that from time to time the balance will swing from one system to the other as improvements are brought out, but any gain obtained by installing the very latest would be small in comparison to the loss entailed in what I may term the break of gauge contest all over again.

I thoroughly agree with you that 1500-volts direct-current is needlessly low, but if it is ever extensively adopted by all means let us stick to it. J. C. G. M.

Central Hotel, Watchet, January 27th.

CHAIN-DRIVEN LOCOMOTIVE.

SIR,—The description and illustration given in your issue of January 18th of the McLaren chain-driven locomotive is an interesting example of how "history repeats itself."

To my own knowledge, Messrs. Clayton and Shuttleworth, of Lincoln, had a similar shunting engine working in their yard thirty years ago, which they had built themselves probably some twenty years earlier, though on this point I cannot speak with certainty.

This locomotive consisted of one of their standard traction engines, boiler and countershafts, mounted on a wrought iron underframe, with wheels and axles resembling those of a modern coal wagon. The design was not perpetuated, as its sphere of activities was greatly limited by the Great Northern Railway refusing to allow it to operate on any of their sidings adjoining the works.

No doubt such a revolutionary design outraged the strict principles of the then locomotive superintendent.

T. NELSON.
Ilford, January 21st.

MUSHET AND BESSEMER STEEL.

SIR,—Two or three days ago my attention was called to an article in THE ENGINEER of the 18th inst., under the heading "Sixty Years Ago." The concluding paragraph is as follows:—"That crotchety and irascible metallurgist, Mr. Mushet, took out a patent for its (manganesian iron) improved use, but wisely allowed his patent to lapse by non-payment of the third year stamp."

Mr. R. F. Mushet took out a patent in 1856 for the introduction of a triple compound of iron, carbon manganese—usually called Spiegeleisen—to molten (pneumatised) cast iron and thereby perfected the Bessemer process. Unfortunately, Mr. Mushet placed his patent in the hands of Thomas Brown, of Ebbw Vale, and Thos. D. Clare, of Birmingham, as trustees, who forgot to pay the renewal premium and thus deprived Mr. Mushet of the control of the pneumatic process of making steel.

R. WOODWARD.
Sheffield, January 28th.

THE GAS TURBINE.

IN a short paper presented before the Institute of Marine Engineers on Tuesday last, Mr. Hugh Campbell summarised some general particulars concerning the progress made and the results obtained with the internal combustion turbines which have already been built. Although progress with the internal combustion engine using the cycles of operation in vogue would seem to be limited to a possible improvement of from 2 to 3 per cent. at the highest, the author expected little from the internal combustion turbine. He expressed the opinion that nearly the whole of the attempts to realise the ideal of a gas turbine have so far been failures or akin to failures, and he feared that a considerable amount of experimental research and a heavy expenditure of money and time would be necessary if such a turbine is to be realised. Some of the difficulties, metallurgical and mechanical, were mentioned, and the Holzwarth turbine described. Reference was made in the paper to the Leich turbine, which works on the constant pressure system and consists, apparently, of a de Laval rotor and nozzles, combined with a labyrinth wheel and a large number of small combustion chambers. According to the statement made to the author by the inventor of this turbine, six machines have already been constructed, including one of 12,500 horse-power, working on blast-furnace gas. Efficiencies of 31 per cent. are said to have been obtained. With the author, we find difficulty in accepting these statements without further confirmation. It certainly seems strange that such large turbines should have been built and run successfully, and no description of them has been given—as far as we are aware—in German scientific transactions dealing with this subject.

Sir George Goodwin presided over the meeting at which, in the absence of the author, the paper was read by Mr. Cozens. A brief discussion followed, and Mr. J. L. Chaloner expressed the opinion that a good exhaust gas turbine would form a useful auxiliary unit, and might lead the way in developing larger sizes of turbines. Mr. Stern gave some interesting particulars concerning the use of exhaust gas turbines for supercharging petrol engines in connection with aero work.

THERE have just been issued as a Stationery Office publication, the Ministry of Transport railway statistics for the month of October last. They reveal that the freight traffic that month was, as regards tonnage conveyed, the best since the Ministry began to keep these statistics, i.e., in January, 1920. It reached 31,281,872 tons, equivalent to an increase of 11.08 per cent. over that of October, 1922. The improvement, too, was general, and under each head—(1) merchandise, (2) coal, coke and patent fuel, and (3) other minerals—the tonnage was higher than in any October since the statistics were instituted. Owing to rates having been reduced on three occasions since October, 1922, the receipts do not show a proportionately good result, but the decrease was only one of £101,265, or 1 per cent. The increase of 11.08 per cent. in tonnage was carried with an increase of 9.3 per cent. in freight train mileage, but as the average haul fell from 52.8 to 52.3 miles, the ton mileage was 10.17 per cent. higher. It is gratifying, too, to hear that the average train load rose from 130¾ to 134¼ tons. The net ton-miles per engine hour remained at 457.

New American Electric Locomotives.

BEFORE the New York terminus of the Pennsylvania Railway between Manhattan Transfer and New York City was put into service, a considerable amount of experimental work was carried out in connection with the electric locomotives now in service. Four locomotives were built and a continuous study of their operation was made by the railway company and the Westinghouse Electric and Manufacturing Company in order to determine which was the best possible type of engine to meet the requirements of the service. With the prospect of main-line electrification in the future and the possibility of the electrification of the Altoona section before many years, the Pennsylvania line built a split-phase locomotive, rated at 4000 horse-power, and placed it in service in the spring of 1917, and this locomotive is now in regular service between Philadelphia and Paoli. In the meantime, however, the railway company's engineering department has been busy designing another type of locomotive for goods service. As an experiment, it decided to equip the same type of locomotive that had been designed primarily for goods service, to operate as a high-speed passenger engine, by simply changing the gear ratio.

At the railway company's Altoona shops three powerful locomotives of the same type are being built. One of them is to be used for goods service on the company's single-phase system, whilst the remaining two are to be subjected to extensive tests with a view to determining their suitability for passenger direct-current service on the New York terminal section of the line.

Each locomotive will weigh approximately 400,000 lb., and will be equipped with four single-phase commutator motors, each capable of developing 760 horse-power continuously, thus giving a combined output of 3040 horse-power. As shown in Fig. 1, the engines have a 2-8-2 wheel arrangement, the cab construction being of the so-called "steeple" type. There are two motors for each jack shaft, and they are mounted outside and at either end of the driving wheel base, each jack shaft serving two pairs of drivers. The connection between the motors and the jack shaft is made by means of pinions and flexible gears. The single-phase goods locomotive will have a gear ratio of 30 : 118 and will run at a maximum speed of 35 miles per hour, whilst the two locomotives that are being designed for direct-current passenger service over the New York tunnel and terminal section will have a gear ratio of 50 : 98, giving a maximum speed of 70 miles per hour. A view of the gearing is given in Fig. 2.

Although two of these locomotives are being designed for direct-current operation, and the third is to operate with alternating-current, the motors and all other parts possible are being made identical. The space required for the transformer on the alternating-current locomotive is, on the direct-current engine, devoted to an accelerating resistance. A pantagraph will be used for collecting the current on the alternating-current locomotive, and a third rail shoe on the direct-current locomotive. Side rods will be utilised for the transmission of power from the jack shaft to drivers. Flexibility between the motor armature and the running gear will be provided for by means of springs set in the gear centre, and flexible pinions in one of each pair of motors geared to their common jack shaft. These springs in the gear centre and in the pinion have been especially devised by the Westinghouse Electric and Manufacturing Company. They are of the leaf type, and are inserted into their pockets without any initial tension. They are so designed that they will be active throughout the operating range of the locomotives. Throughout the design of these locomotives, the underlying principle adhered to has been that of extreme simplicity.

The outstanding feature of the alternating-current locomotive is that each motor has the greatest capacity of any single-phase commutator type traction motor that has ever been built in America. The main frame of the locomotive is designed and machined, so that it forms a cradle into which the motors are inserted, thus making them integral parts of the frame. The motor bearings are carried on the side frames of the locomotives, and are entirely separate from the main frame of the motor itself, but are integral with the motor cradle. In order to maintain the high rating previously mentioned, forced ventilation has been necessary, air being drawn through the motors instead of blowing it through, as has been the usual practice with forced ventilation.

Another interesting and novel feature of this locomotive is the use of an oil-insulated, force-cooled transformer. The tank of the transformer is built into the locomotive, but it is entirely separate from the cab structure. Its base rests on pads on the locomotive main frame, while the top is formed by a portion of the cab roof, but at no point is it rigidly connected to the cab structure. The sides of this tank are formed from a single sheet of steel, with a vertical seam jointed by a double row of rivets. The bottom of the tank, which is an integral cup-shaped piece, is set into the side sheets and riveted into place. The transformer oil will be cooled by being pumped through a forced ventilation radiator. A single motor is provided to drive both the oil pump and the blower which provides the ventilating air. The locomotive roof is constructed so that the removal of the transformer core from the locomotive can be accomplished by simply removing that portion of the roof directly over the transformer. Two motor-driven blower sets are provided, one for each pair of traction motors. The motors driving these sets and the motor driving the oil pump and blower are indentical with the single exception of the shaft extension. This feature lends itself to simplicity and ease of maintenance.

The control gear for the traction motors is very simple. The apparatus consists of a master controller—see Fig. 3—a reverser, the necessary unit switches for a notch-by-notch voltage increase to the normal voltage of the traction motors, preventive coils, and the minimum number of relays consistent with safety. In addition to this apparatus, there is a small motor generator set used for charging the storage battery, which furnishes the energy for the control apparatus and lights. The brake system is of the standard locomotive type, the brake lever system being designed for clasp brakes, and giving 100 per cent. braking power at the driving wheel.

The locomotive capacity is as follows:—

	Continuous.	Hourly.
Tractive effort, lb.	50,000 ..	62,000
Speed, miles per hour	23 ..	19.75
Maximum tractive effort (at 33½ per cent. adhesion), lb. ..		100,000
Maximum speed, miles per hour	..	35

The traction motors of the direct-current locomotives are identical with those used on the goods locomotive, and with the gearing provided the locomotives are capable of handling the largest Pullman train entering or leaving the New York terminus. The blower sets are also the same as those on the alternating-current locomotive. A number of parts on the direct-current locomotives, which cannot be made the same as the parts on the alternating-current engine, have been made to correspond with the parts on the present tunnel and terminal locomotives, and among these parts are the third-rail shoes, resistance grids, &c.

The direct-current locomotives have the distinction of being equipped with what are claimed to be the largest unit switches in existence. These switches are of the standard Westinghouse electro-pneumatic type, and have a continuous capacity of 3000 ampères. The arc-rupturing capacity of these switches is many times that amount on a 750-volt circuit. A total of twenty-three switches is required on each locomotive to handle the motor circuits.

These locomotives will be completed and placed in service early this year, and it is proposed to make extensive tests to determine the practicability of this form of engine, both for high-speed passenger and for goods service. If the expectations of the railway officials are fulfilled, a tremendous advance will have been accomplished in electric locomotive design by this adaptation of one locomotive to both goods and passenger service.

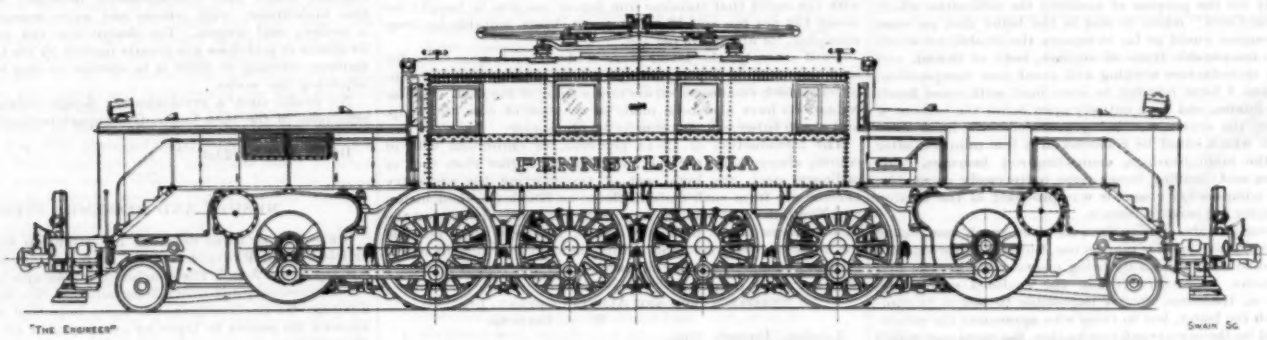


FIG. 1—3040 H.P. SINGLE-PHASE ELECTRIC LOCOMOTIVE FOR THE PENNSYLVANIA RAILWAY

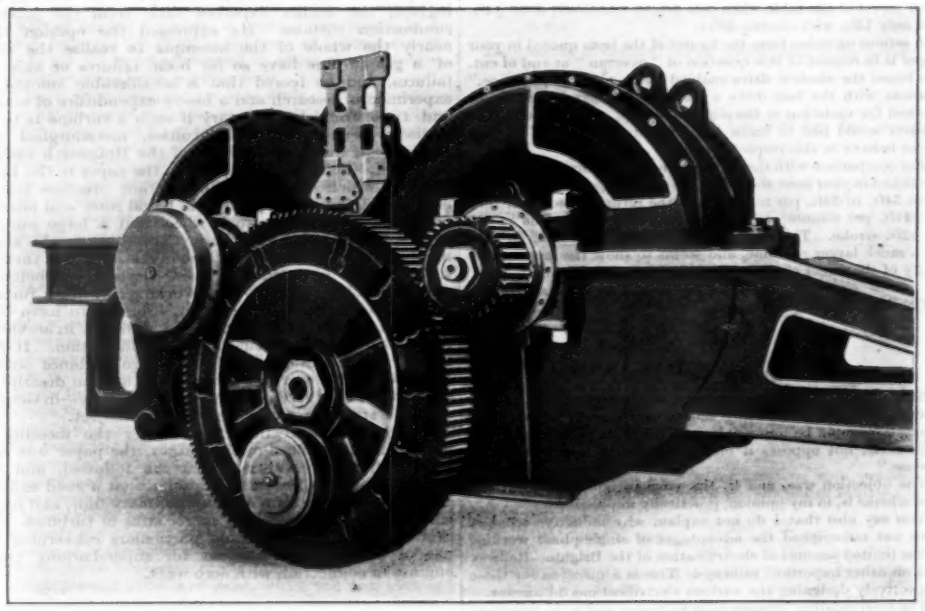


FIG. 2—GEARING BETWEEN MOTOR AND JACK SHAFT

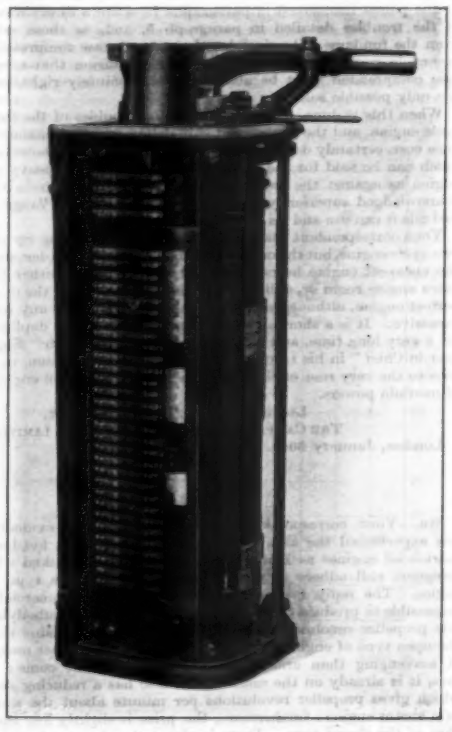


FIG. 3—MASTER CONTROLLER

KING'S COLLEGE ENGINEERING SOCIETY.—The King's College Engineering Society is holding its anniversary meeting at the Institution of Mechanical Engineers on February 12th, at 5.30 p.m. Vice-Admiral Sir George Goodwin, K.C.B., will address the meeting on the subject of "Economics as Applied to Mechanical Engineering," and the chair will be taken by Sir John Dewrance, K.B.E., President of the Institution of Mechanical Engineers.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

The Midland iron and steel market is marking time, awaiting more settled conditions. Very few orders are passing, but now that the railway strike is over, the outlook is considered rather favourable, having regard to the state of order books and the amount of work pending. The strike has caused much less inconvenience than might have been expected, and, so far as deliveries of raw material go, each day saw a little improvement. In the Black Country the canals have once again saved the situation by enabling the fuel to be brought direct from the collieries in Cannock or Warwickshire to the wharves of the forges and mills. Certain establishments not having canal service have been more hardly hit. Unfortunately, owing to shortage of fuel and raw material, it was found necessary on Monday to close the Old Hill Ironworks of N. Hingley and Sons. Hopes are expressed in industrial circles hereabouts that now that a settlement of the dispute has been reached, further labour trouble will not develop. Local iron and steel masters have trouble enough in foreign competition, which is becoming increasingly severe. While Staffordshire ironmasters have ignored it and raised their prices, steelmasters have been forced to concede ground in the semi-finished material department.

The Late Sir George Bean.

By the death last week in his sixty-eighth year of Sir George Bean, Midland—and particularly Black Country—industry has lost one of its most prominent leaders. Sir George, by his untiring activities, zeal and devotion to public duty, brought fame to the Midlands. His name will be included in the long and honoured list of men who have helped to build up the industrial fame of this country. As a comparatively young man, he became connected with the firm of A. Harper, Son and Bean, Limited, of Dudley, and saw the rise of a small concern to one of world-wide reputation. Originally the firm was engaged in the iron trade, but later became stampers and shell manufacturers. The experience gained by the firm resulted on the outbreak of the war in its services being requisitioned by the Government for the provision of munitions. The developments that followed constitute a romance in industrial enterprise. In an incredibly short space of time, one of the largest factories in the Midlands was built on a site adjoining the firm's works. Then followed the erection of an enormous factory at Tipton, which, together with the munition works at Dudley, was placed under the control of Sir George and his only son, Mr. J. H. Bean. At the factories at Dudley, Tipton and Smethwick, in all of which Sir George had either a proprietary or controlling interest, there were employed at one period of the war some 17,000 people. When peace came, Sir George was one of the first manufacturers in the country to adapt his works to the "change-over" circumstances. He saw the public demand which was certain to arise for motor cars a little better than the cheap variety. The result was the building up of a huge motor industry, the factories at Dudley, Tipton and Smethwick all being utilised. The total number of people employed at the three works at present is about 3000. In addition to his association with the firm bearing his name, Sir George was chairman of Allen Everitt and Sons, Smethwick, and Manning, Wardle and Co., Limited.

Steel Values Falling.

Orders for steel are not being placed in any quantity, through the uncertainty as to the time of delivery, and the future trend of prices. But there is a fair amount of inquiry for all classes of material. Work at the mills is restricted to steel urgently called for, or most advantageously produced from the fuel point of view. In many cases, power is generated by gas producers, the fuel for which has to be delivered by rail. In some cases also, stocks are not available. Some of the large steel works in other parts of the country have been at a standstill, but most of the mills in this district continued in operation throughout the dispute. Steelmakers are increasingly concerned at the position which has developed in respect of foreign competition, which they consider is likely to become increasingly severe. Some producers are stated to be actually buying continental steel themselves for re-rolling, seeing that it can be obtained at very considerably less than the production cost per ton here. The price movements which have taken effect this week have been dictated for the most part by the aggressiveness of foreign competition. Soft billet values have gradually declined, until to-day it is unlikely that a good order at £8 would fail of acceptance. Belgian billets can be obtained at £6 10s., and many good orders are said to have been recently booked at this figure. Continental steel bars at £7 15s., or even less, emphasise the incongruity of the scale of £10 10s. to £11, which still applies nominally in the home trade. Many native re-rollers, however, would be well content to get a little over £10 per ton for their product. Belgian prices are also much below English for joists and plates, and it is not surprising that the upward movement in home prices has received a check. Joists are still quoted £10, ship, bridge and tank plates £10 10s., and boiler plates £14 delivered. The disparity in home and import prices of wire rods is not so great, but it is considerable. Steel strip for tube making is quoted by local producers at £10 15s. One of the effects of the railway strike has been to retard deliveries of foreign billets, but most re-rollers are fairly supplied.

Scrap Dearer.

There is an improved demand for steel scrap, and prices have hardened somewhat. The slump has apparently ceased for the present, merchants having very good inquiries for supplies. Heavy steel scrap has this week been sold at £4 15s., which is an advance of 7s. 6d. per ton on the price ruling at the opening of the year.

Blast-furnace Fuel Supplies.

The pig iron situation, apart from the difficulty lately experienced of securing adequate supplies of fuel, due mainly to the strike on the railways, is unaltered. There is no particular shortage, works having bought rather freely at the end of last year. As a rule, stocks of raw material will enable the Staffordshire ironworks to carry on for some time. Blast-furnace owners, however, are not so fortunate as regards their supplies of raw material. The extended system of delivery by motor rendered Black Country smelters less dependent than other districts on the railways, and fuel found its way to the furnaces in increasing quantities by way of the canals. But smelting necessarily calls for abundance of coke. Single furnaces require anything from 1000 to 5000 tons per week, according to capacity. This quantity cannot be stocked, and the furnaces can only be maintained by a regular system of delivery. For some time, stocks have been below the normal, owing to the scarcity of coke, and though a total stoppage at the furnaces blowing in this area was not considered to be likely, some considerable curtailment of output would have been necessary if the strike had been much longer extended. At the moment, demand for pig iron is quiet, and consumers are able to resist efforts to raise values to meet the advanced production costs. North Staffordshire forge iron is quoted £4 10s. upwards, and No. 3 foundry £4 17s. 6d. to £5. Northamptonshire forge is £4 7s. 6d., and foundry £4 13s. 6d. upwards. Derbyshire makes command forge £4 8s. to £4 10s., and foundry £4 15s. to £4 17s. 6d.

Staffordshire Iron Prices Advancing.

Staffordshire ironworks have fair order books, and look for expanding business now that railway troubles are out of the way. Prices have become firmer during the week, merchant iron having risen in value by from half-a-crown to 5s. per ton. Crown bars, which for some time have been £12 10s., are now quoted at £12 15s., and iron gas tube strip at £13, a rise of 2s. 6d. per ton. In spite of keen foreign competition, nut and bolt bars have hardened to £11 10s. There has been a further fall in Belgian quotations for No. 3 iron this week, but the home market is moving in disregard of this competition, notwithstanding that it has assumed a very real character. Lancashire mills show their independence by putting 2s. 6d. on their former price of £11 10s. South Staffordshire makers will not entertain less than £11 5s., and most of them want £11 10s. Even these figures are regarded as unprofitable, though they seem irreconcilable with the Belgian price of £8 10s. Home makers complain that their profits are disappearing as the result of dearer works coal and more costly pig iron. Till the market became dormant, the Staffordshire ironworks were getting a certain amount of business, though it was a diminishing quantity. There is a steady undertone in regard to marked bars, which remain unaltered at £14 10s. per ton.

Little New Sheet Business.

The galvanised sheet trade continues busy, largely, however, on old contracts, some of which will keep the mills employed nearly through the half year. The lack of new business has weakened prices, and it is now possible to secure supplies of 24 gauge galvanised corrugated sheets at £18 5s. to £18 7s. 6d. f.o.b., with the customary extras for thinner gauges. This is a fall of half-a-crown to 5s. per ton on the recent figure of £18 10s. The tin-plate trade also continues very well employed, and is making very heavy shipments, as indicated by the recent Board of Trade returns.

Canal Transport.

The question of canal transport is receiving a good deal of attention in industrial circles here just now, and some disappointment is felt at the mildness of the report of the Special Canals Committee of the Birmingham City Council, appointed to investigate possible canal development schemes designed to improve Birmingham's water communication with the seaboard. It is still possible—though probable would be too strong a word—that a great enterprise will be attempted, but the investigations which have dealt with the Gloucester–Bristol route, as the most practicable and economic, go to show that the promoters of the scheme must be prepared to face an annual loss upon working. It is reported that to bring up the waterway to the 100-ton barge standard would cost two and a-half millions, or to the 80-ton standard £1,640,120. By the postponement of certain items of improvement, the initial expenditure might be brought down to £1,320,120. While the desirability of such a means of conveyance of Birmingham goods to the coast is generally agreed upon, the enterprise is now looked upon as hazardous, especially when it is remembered that the certainty of further developments, alike in railway organisation and in road transport, have to be reckoned with in deciding whether such a scheme could be made to pay.

Railway Material.

There is reason to believe that Midland firms are getting an increasing share of the growing business in railway materials, the exports of which advanced from 46,864 tons in November to 51,430 tons in December last. Some very welcome orders have been taken, both for rolling stock and structural material, including bridge-work for developments at home and abroad. Engineers in this district have work on hand for South America, South Africa, Australia, Mombasa, and other parts of the world, and they hope to do more business with China as the result of the industrial commission which is now over here. The Crown Agents are again placing a certain amount of business, after a period of comparative inactivity.

Continued Decline in Unemployment.

The unemployment returns for the Midlands area show a further steady decline, the numbers having fallen during the week from 157,671 to 155,083. The total is made up of 110,320 men, 3446 boys, 36,499 women and 4818 girls. There is a decline in the Birmingham area of 1497, in Bilston of 155, Coventry 138, Cradley Heath 146, Dudley 101, Oldbury 34, Smethwick 48, Stourbridge and Brierley Hill 205, Wolverhampton 222; while the West Bromwich figures show an increase of 50.

SHEFFIELD.

(From our own Correspondent.)

Effect of the Railway Strike.

The settlement of the railway strike gave great satisfaction to all engaged in Sheffield trade. Fears are, however, expressed that the trouble, although of such short duration, has had a detrimental effect on the trade revival, and there can be no doubt, if it had been prolonged, its results would have been most serious. It would soon have involved the shutting down of works, and a complete paralysis of industry. As it is, the stoppage of production, although bad enough, has been only of a limited nature. Firms in Sheffield are very ill-prepared to deal with an emergency which interferes with the regular supply of fuel. They use enormous quantities, and have no space in which to store reserves. Even such space as some of them did possess in former years was, to a large extent, devoted to the erection of new buildings during the war, so that the works are more than ever dependent on the continuous, almost daily, receipt of supplies of fuel. Fortunately, in spite of the strike, the local railway companies were able to give a fair service to all the firms possessing sidings of their own. At the same time, the firms had to exercise the greatest economy, and had to close down some departments. The situation imposed a good deal of strain, but did not lead to anything like a large shutting down, such as would have been inevitable if the dispute had lasted much longer.

State of the Steel Trade.

There was, naturally, very little business done in the steel trade during the past week. The volume carried on, except in those works which had to limit their operations, was on about the same scale as previously reported, but the placing of new business naturally fell off very considerably. Both buying and selling were discouraged. It was believed all the time, however, that a large amount of business was waiting to be given out as soon as the dispute was finished, and confidence in an early strengthening of the position is, therefore, well maintained. A few railway orders came to hand during the week, though none was of any great magnitude. The railway steel departments continue to enjoy a large measure of activity.

The Finished Sections.

The improvement in the demand for all kinds of tools made in Sheffield continues, and is one of the most satisfactory signs of the times. Many firms report that the inquiries they are now receiving are on a much better scale than they have known for the past three years. In the file trade, work is proceeding at about 70 per cent. of full capacity. A good order from Russia is on hand, as well as work for the home Government. The position of this branch is a great deal better than it has been for a considerable time, and, although there is still a certain amount of unemployment, it does not affect the skilled hands to any large extent. Much of the business being done, however, is said to be unremunerative. There is a good demand for twist drills, hacksaws, saws, hammers, picks and shovels, all indicating a better state of employment in the shipyards, engineering shops, and quarries of the country. An improvement is also noticeable in the overseas trade. The departments in question, however, are still far from fully engaged, and business is very keenly competed for.

The Cutlery Trade.

Conditions in this trade vary, and, on the whole, cannot be called satisfactory. Some firms find a falling off even in the demand for stainless table knives, but this is not a common experience, as that branch on the whole keeps up very well. The recent case of false marking of stainless steel cutlery has led to a newspaper correspondence, in which the cutlery manufacturers are strongly urging upon the public the danger of accepting the name of a certain steel as a guarantee of the quality of the knife. They point out that, however good the material may be, it is the workmanship of the cutler which determines the quality of the knife, and that the public should insist on seeing the mark of a reputable cutlery house on the knives which they buy. Another point, which is being pressed prominently upon the attention of the cutlery manufacturers themselves, is that by stamping the name of a certain steel on their knives they are taking a step which is liable to reduce the value of their own trade marks. Although German competition has fallen off considerably, the spring knife trade in Sheffield is only enjoying a moderate amount of activity. There is some improvement in the demand for razors of the ordinary pattern, but the trade is still far from satisfactory. Sheffield is turning out a fair number of safety razor blades.

Silver and Electro-plate.

The branches making the best classes of silver and electro-plated goods are still far from well employed. The demand for high-class hollow-ware has been poor for a considerable time, and some firms report a further falling off during the past fortnight. There is, however, still a brisk demand for spoons and forks, and inexpensive ware. A number of good orders for table equipment are on hand from caterers, hotels and shipping companies, but the demand from the last-named quarter is not up to normal proportions.

A Railless Car Recommendation.

One of the most interesting items of news of the

week comes from Bradford, in the shape of a report by Mr. J. H. Wilkinson, manager of the Corporation Tramways, on the question of converting the present tramway system into one of trackless cars. Mr. Wilkinson estimates that the change would result in a saving, in route maintenance costs, of no less than £51,000 per year. He proposes a gradual conversion to be carried out as the existing lines need replacing, and considers that there are satisfactory reasons for equipping three or four routes with railless at present. He estimates the cost of the conversion as follows:—Return feeders, £128,320; overhead line, £93,000; reinstatement of roads, £382,000; making a total of £603,320, which would be spread over a period of fifteen years, the average life of the permanent way. Giving comparative figures with regard to the present system, he calculates that the expenditure on the permanent way during the same period would probably amount to £1,050,000, taking an average rate of £70,000 per annum, which is £20,000 less than the average for the past five years. In the case of railless vehicles an annual tax of £70 each has to be paid to cover road maintenance costs, and for 270 vehicles the total tax would be £18,900, resulting in an annual saving, compared with the estimated cost of track renewals and maintenance, of £51,100. On steep gradients, Mr. Wilkinson recommends single-deck vehicles, on the grounds of safety and economy. Dealing with the liability of railless vehicles to side-skid, particularly in snowy weather, he says skidding in snow can be counteracted by non-skid attachments and the cleaning and salting of the roads. He further points out that delay in foggy weather can be minimised by a simple indicator showing the driver his position in the road in relation to the trolley wires.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE markets generally for iron and metals remain on the quiet side, although there are some exceptions. Where prices are better, however, it is in connection with some expected shortage, and the movements do not seem to indicate what we want to see, viz., a general and widespread increase in demand and in consumption. It is to be feared that the movement in that direction which was anticipated before the end of last year has been checked for the moment, although it may come on in the spring. By that time commercial men will probably be able to see what may be expected from the new Government, and part of the natural anxiety with which the radical change in our outlook must necessarily be accompanied may have passed away. Certainly, if any progress can be made in the pacification and reconstruction of Europe, it will have a good effect on British trade, and especially if it be possible, under the new auspices, to renew safe trading with Russia. This is particularly interesting to the engineer, for if safe conditions can be secured there is a big field for him in Russia.

Metals.

The slight improvement in standard and electrolytic copper is generally attributed to the weakness of sterling, and if this view be true, it is certainly not a matter for congratulation. Those merchants who are expert in the copper trade here seem to take rather a gloomy view of the future, and evidently do not believe in the permanence of any improvement in this market. Yet it must be admitted that prices are low, and now that the value of sterling is about 15 per cent. below par, they are really much lower than they seem to be. One has to recognise that if copper were quoted in a gold currency, the price here would be nearer £52 than £62 per ton. It is said that there is now a much better demand from Germany for copper, and it may be hoped that this means a certain recovery in German industrial conditions, which cannot be without its effect upon European trade. If we could see a recovery in Russian industrial conditions, we might begin to hope that the worst was over; but in any case a larger consumption of copper in Germany will do a good deal to strengthen the market position. For a long time copper prices have been at, or near, the bottom, and probably consumers may safely hold larger stocks. Makers of strong copper sheets have reverted to the old price of £95 per ton. The demand for scrap metals has not shown any improvement lately, and the market for scrap remains stagnant. Dealers here are still paying only £46 for good gun-metal scrap and £36 for heavy yellow brass scrap. In spite of the considerable advance which has occurred in tin since the beginning of the year, there seems to be considerable confidence in the market amongst merchants in this district. It is pointed out that the consumption is sensibly in advance of the output, and that the reserves of tin in the East are getting small. Just at the moment the fuel difficulty has led to some curtailment of the consumption in South Wales in the tin-plate trade, but this is probably quite temporary, and the American consumption in this trade is enormous. Engineering does not consume very much at the moment, but if this demand should begin to revive it might have an effect on prices quite out of proportion to its size. Certainly, the market needs careful watching in these times. Lead and spelter have both been firm markets, and there is, as I write, no sign of any coming reaction.

Pig Iron.

The markets for foundry iron in Manchester do not yet show much movement. The failure of general business to expand in January, as was so confidently expected, is, of course, disappointing, but the present dulness of pig iron is not altogether accounted for by this. The prospects of much dearer coke and some chance of a coal strike and a fuel famine before the spring is over, ought to induce all consumers of pig iron to buy more freely. But this week one sees no sign of anxiety to buy. At the same time, there is no pressure to sell and the market is stagnant. Continental foundry pig iron is now quoted at only a little over the equivalent of 80s. f.o.b., and the great difference between this and the price for Cleveland pig is a serious matter for the British trade. It seems to suggest that the output of British pig iron must be kept low until more equal prices are re-established. The Scottish and Cleveland makers may have, after all, to consider the possibility of selling more iron to Lancashire, which market they have disregarded for quite a long time. Prices here are unchanged, and are based generally on 95s. at the Derbyshire furnaces, although one or two of those furnaces are still quoting 96s. per ton. Basic pig iron is rather weak again, but this may be because foreign basic iron is to be had at 82s. 6d. per ton f.o.b.

Steel.

The continental market is steadily getting more dangerous for the British steel manufacturer. It is stated, although one finds it difficult to believe, that Belgian joists and large sections have been offered at £6 2s. 6d. per ton f.o.b., as against the £10 per ton delivered in Manchester, which is the Association price. A difference of £2 per ton might perhaps be disregarded; but when it comes to £4 per ton the situation is certainly unstable. Yet it does not seem possible to reduce British prices so long as the cost of production remains where it is, and apparently the chances are that this cost will increase rather than diminish. The actual causes of this great disparity in price ought to be very seriously investigated in the general interests of the British steel trade. It is absurd to attribute it all, in a lump, to exchange movements.

Scrap.

There is little of a cheerful character to be written about the market for iron and steel scrap. No improvement has occurred in the demand for cast scrap, and, if anything, dealers seem inclined to accept lower prices, although this will not stimulate buying; for if the foundrymen wanted the scrap, price is already low enough in comparison with pig iron. Heavy wrought scrap is fairly steady at from 97s. 6d. to 102s. per ton; but there is not a great deal of this on the market here. Steel scrap is perhaps a little better than it was at the beginning of the month, but not nearly so strong as at the end of December.

The Effects of the Strike.

The news of the settlement of the railway strike was received here with much satisfaction, but all deliveries are still in confusion, and it will be a day or two before one can say whether this settlement will have any stimulating effect on our markets. At present, it seems to be taken with a good deal of indifference, for it was not the strike or the fear of the strike which caused the setback in the second week of January. Two things are troubling the market at the moment, viz., the dread of a long coal strike in the spring or early summer and the terribly low prices which are being quoted on the Continent.

BARROW-IN-FURNESS.

Hematite.

The railway strike affected this district, as it did all others, and the market at the time of writing is still dull. There has been a restriction of output, and an Ulverston furnace has been damped down, but may be working again in the course of a few days. A certain amount of fuel came through to Barrow, despite the strike, but the demands of the various works could not have been met in the long run. The trade, generally speaking, apart from suffering from the after effects of the labour trouble, is quiet, and there is a certain amount of material going into stock. Buyers do not seem inclined to deviate from their recent custom of buying only for immediate requirements, and that rather suggests a lack of confidence which a short time ago seemed to be more noticeable in the market. The Midlands are fair customers, but their orders are not of great bulk, and the same remark applies to Scotland. The continental trade continues very moderate, and the amount of business with America is not great. A cargo of pig iron left Barrow last week for Philadelphia, *viâ* Liverpool. An interesting development in connection with shipping from Barrow is the inauguration of regular sailings to New York by the Furness Withy Line. There is to be a regular service between Liverpool, Barrow and Belfast to New York, and it is possible that this may help the American business.

Iron Ore.

The iron ore trade is dull, and there is no immediate prospect of an improvement. Some of the mines are doing very little. The importation of foreign ore is on a small scale and is likely to remain so for some time, until the iron trade improves.

Steel.

The steel trade is fairly promising, but at present there is very little being turned out. The Barrow rail and merchant mills had to stop at the end of last week, through the strike, but will be starting again. There are orders in the market, but the prices are finely cut. The hoop and section mills are better situated for orders than other branches of the steel trade.

Shipbuilding.

The Donaldson liner Gracia has arrived at Barrow to be fitted with refrigerating machinery and have her holds insulated to enable her to carry frozen and chillep meat. This vessel is over 6000 tons in displacement.

NORTH OF ENGLAND.

(From our own Correspondent.)

The General Trade Position.

THE settlement of the railway strike was very timely. Although there had been no serious dislocation of industry in the North of England, and a fairly satisfactory mineral train service had been maintained throughout the dispute, many of the works were getting anxious about securing adequate supplies of fuel, and a few more days might have caused a curtailment of operations and the damping down of a number of furnaces. Happily, that has now been avoided, and there is now a more cheerful view taken of the outlook for industry generally, though the threat of a dock strike is causing a good deal of anxiety.

Cleveland Iron Trade.

Business in the Cleveland pig iron trade rules on restricted lines. Foreign competition has become increasingly keen; indeed, Cleveland makers have been ousted out of many markets abroad. Shipments overseas from Cleveland during January were on a fairly heavy scale, but that was largely due to the completion of old contracts. Little fresh business has been placed, merchants complaining that export orders are practically unobtainable, prices being 10s. to 15s. per ton too high. The home trade, too, is quiet. Sales to Scotland are on an extremely limited scale, Belgian and French iron underselling Cleveland pig very substantially in the Scotch market, whilst foreign iron is now being fairly freely purchased for use in this district. Under such conditions reductions in Cleveland pig iron quotations are looked for. In the meantime, No. 1 is quoted at 101s.; No. 3 G.M.B., 98s. 6d. to 99s.; No. 4 foundry, 96s., and No. 4 forge, 95s.

Hematite Pig Iron.

In the East Coast hematite pig iron trade, makers are gradually working off old contracts, and are not easily replacing them. Prices show a weakening tendency, and whilst more is asked in some quarters, mixed numbers are now readily obtainable at 102s., and No. 1 at 103s.

Ironmaking Materials.

The foreign ore trade is idle, but deliveries under running contracts continue heavy. Best Rubio ore is nominal at 24s. c.i.f. Tees. Good medium furnace coke ranges from 36s. to 36s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

There is still a good deal of keen foreign competition in the manufactured iron and steel trade, particularly for semi-manufactured steel, and this is inducing buyers to hold off the market in the hope of lower prices. Deliveries, too, have been very irregular owing to the railway strike, and there has, consequently, been little fresh business. It is hoped, however, that the settlement of the railway dispute will bring in more business, as it is believed that a considerable tonnage of manufactured iron and steel will be needed for constructional work. Quotations are firmly maintained.

The Coal Trade.

There has been no special development in the Northern coal trade. Fitters are doing their utmost to meet the pressure for supplies, but their efforts are sorely checked by the transport difficulties. They can only depend on a limited supply of wagons, and, on the whole, it is little better than two-thirds of the ordinary average. The supply of wagons, however, is increasing in proportion to increased engine power, and at all shipping centres on the North-East Coast the position is reported to be more favourable, while at many points a distinct improvement is recorded. There is a good all-round inquiry, not only for prompt lots, but also forward for the next two or three months; but business is held in abeyance until the labour atmosphere clears up. Cargoes for prompt shipment are practically unobtainable, and only limited quantities are occasionally offered on the market. Buyers for these compete keenly, but hold against paying higher than 27s. 6d., and in one or two instances higher figures have been paid. The coaling stations, especially Port Said, are pressing for supplies. Best Northumberland steams for prompt deliveries are nominal. For February sellers offer 26s., but fail to tempt business. Coking coals are offered for next month at 24s. 6d. for ordinary qualities, but there is no pressure to operate at this figure. Bunker coals are in demand, and 27s. to 28s. is being offered for good ordinary Durham unscreened. There is a good general inquiry for coke, and, while makers quote steady values, the actual value depends entirely on the question of delivery.

SCOTLAND.

(From our own Correspondent.)

Traffic Difficulties.

THE railway strike, with its accompanying disorganisation of traffic, more or less played havoc with trade in general during the past week. In some districts, particularly those served by the Caledonian portion of the London, Midland and Scottish Railway system, the situation was not so severe, but even in these the amount of traffic possible was only sufficient to keep things going on a minimum scale.

New Contracts.

Despite the prevailing uncertainty of the times evidence is not lacking that some view the future with a fair amount of confidence. So far as regards orders on hand, the Clyde is comparatively well placed, and the number is still being added to. Two contracts have just been announced for new cargo vessels, one of 5500 tons deadweight and one of 9000 tons carrying capacity.

Steel and Iron: Continental Competition.

The prevalence of offers of cheap continental material is having a more definite effect on home industries. Local makers have endeavoured to maintain

prices, but consumers are convinced that levels must drop and are buying cautiously. Only immediate requirements are entertained. In the steel sheet trade which has preserved a measure of activity throughout the lean period a quieter tone is now apparent. A fair number of orders are still on hand, but a lull in new business, especially on export account, has arrived. Home demands, too, are not very good. Steel plates and sectional material remain comparatively quiet. The bar iron works also feel a lack of fresh business. Both home and export demands are rather disappointing, the former especially so, in view of expectations from railway contracts and shipyard requirements. The latter, however, have not had time to expand fully, and the expected business may yet come forward. The re-rolled steel branch of the bar iron trade is suffering more than a little from competition from cheap Belgian bars, both in home and foreign markets. Cheaper prices for the home product are likely. The drop in continental basic iron is affecting the pig iron market to some extent, and prices are tending easier. Foundry qualities have already dropped about 2s. per ton, and are likely to cheapen further. Hematite has remained on the same level for some time now, but is also becoming affected. Scrap material is more plentiful owing to heavier imports, but consumers are not showing any anxiety to purchase, especially in respect to heavy smelting material, prices of which are sagging. Home steel prices are unchanged, but in most cases export business could be done at considerably cheaper rates.

Coal.

The coal trade is still more or less disorganised by the railway strike. The congestion at the collieries, caused by an accumulation of loaded wagons, resulted in much idleness and reduced outputs. Transport difficulties, too, caused delays to steamers at almost all ports, and shipments this week will probably show a drop even over last week's figures of 187,394 tons, which compare with 274,838 tons in the preceding week and 311,226 tons in the same week last year. Coastwise traffic as well as foreign traffic is largely affected. New business is almost impossible at present and the market is featureless. The home market is likewise extremely difficult to maintain. Supplies to merchants are most irregular, and many industrial concerns are very short. For any available lots prices are purely a matter of arrangement. In the absence of business export quotations are practically nominal and unchanged.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

EXCEPT in the case of small parcels of coal standing on the docks and sidings, which were required by exporters for bunkers or to complete cargoes, business all last week was at a standstill, and the conditions this week are not much, if any, better, notwithstanding the settlement of the strike on the railways. It will be next week at the earliest before the troubles which inevitably follow in the wake of a stoppage are overcome. In fact, the effects of the strike will be felt in all probability for a fortnight, for the reason that the bulk of collieries are behind in their deliveries, and have lost practically a week's output. Tonnage now in dock will keep collieries busy for about ten days. Naturally, the market is firm for coals for prompt shipment, as most undertakings have no coal to spare, in view of their heavy commitments. At the same time, it is significant that with the exception of anxiety being felt by some of the foreign depôt owners, on account of some of the depôts being practically depleted of their stocks, there has been no apparent alarm among foreign consumers at the fact that they have been to a large extent cut off from this district for coal supplies, and the settlement of the strike has not so far been followed by a very pressing inquiry for cargoes, except in isolated instances. Unfortunately, several cargoes of American coal have been booked for Italy and Port Said, which means less coal required from this country; but whether these American cargoes have been arranged on account of price or fear that labour troubles in this country were likely to be prolonged, is not quite clear, as it is well known that past experience of the American product has not been by any means satisfactory. It is much to be regretted that the outlook with regard to labour is not more cheerful, as apart from the question of the miners' wages agreement being terminated, there is now the grave development in the position as it affects the transport workers, who threaten to withdraw their labour on February 16th unless their demand for a 2s. advance per day is conceded. Strikes and threats of stoppages make it extremely difficult for business men to tackle contracts for the supply of coal over extended periods, as, for instance, that for the supply of 200,000 tons of steam coals for the Egyptian State Railways for delivery over five months as from March. Tenders for this business have to be in by February 5th, and hold firm for ten days. The opinion prevails that the Americans will bid keenly for this order, and if this is the case it is not improbable that the placing of the business will be governed, not only by the actual prices that are sent in, but also by the state of labour conditions and the outlook generally.

The Strike on the Railways.

Reflecting on the conditions which prevailed last week, it cannot be denied that the Great Western Railway Company did extremely well in its arrangements to meet the action of the strikers in this district. With the limited supply of labour and engine power, some very good work was done at the docks and on the railways generally. There were, of course, the usual crop of complications for business men, arising from the fact that the strike was only partial in its effect upon the working of the collieries, and many no doubt would have preferred that it should have amounted to a complete stoppage of work at the pits, and so relieve them of awkward problems; but from the point of view of the general public, and the provision of employment for other classes of workmen than the locomotive men, the position might have been very much worse. As each day passed last week, it became more evident that the Great Western Company was getting a closer grip upon the situation, and before the end of the week some of the men belonging to the National Union of Railwaymen who had been tempted to throw in their lot with the strikers, deemed it wiser to carry out the behest of their leaders and keep at work. By Saturday last the position had improved so that there were as many as seventy steamers in South Wales ports on which the loading of coal was proceeding. This may not appear to be a large number when it is considered that there were well over 450 vessels altogether in the docks, but it was better than was ever expected. At the same time, it should be made clear that loading operations on these seventy vessels were not continuous and without interruption, as it could not be expected that coals could be moved so freely; but having shipped the bulk of the coals standing on the docks and sidings, the Great Western Company had so far perfected its arrangements as to be able to get some coals through from the collieries to the ports. It was a case of daily improvement, inasmuch as on Monday the number of steamers on which loading was being carried on increased to eighty-eight. Furthermore, it was very satisfactory to find that while the passenger traffic was being dealt with more to the advantage of the public, the company was also able to move coals to tide over the difficulties of many of the steel and other works in the various centres, thus enabling them to resume operations or assist them to avoid stopping. On Tuesday the Great Western Company estimated that it had 80 per cent. of its engine power available, so that the prospects of getting normal traffic conditions before the end of this week are bright, and the bulk of collieries should by this time also have made a restart.

Development of Newport.

The secretary of the Newport Development Association at the annual meeting of that organisation on Monday reported that during the past twelve months he had had 618 interviews with merchants, manufacturers, shipping companies, railway companies, &c., in London, Birmingham and elsewhere, and that there were twelve direct inquiries dealt with by the Association relative to sites in the neighbourhood. Important projects in connection with which inquiries and negotiations were still in progress included 20 to 30 acres for steel works, a site for regenerator ovens (in connection with the oil industry), a timber yard site, and a quayside site with railway connections. The Great Western Railway Company had decided to provide additional sidings to make accommodation for 3500 extra wagons for coal shipment. The promise of the Nippon Kaisha Line to make Newport a port of call had been fulfilled, and the Association had been successful in obtaining traffic from one of the Conference Lines of New Zealand.

Current Business.

The coal market has not yet settled down, and it will be some days before it will do so. The tone of the market is, however, firm, on account of the scarcity of coals, and the fact that collieries have such heavy commitments and so much tonnage waiting to load. Best Admiralty large coals are in the neighbourhood of 30s. to 31s., and second qualities about 29s., while Monmouthshire large coals are quoted about 29s. to 30s., but values are for the moment more of a nominal character than anything else, as the amount of actual business that is being done is negligible. Small coals are especially scarce, and for coking qualities sellers are indicating as much as 24s. to 25s., with good steam descriptions 22s. to 23s. Patent fuel manufacturers are not quoting, as they have no fuel to offer for the time being.

CALENDARS, DIARIES, &c.

MARSHALL, SONS AND CO., Limited, Gainsborough.—Wall calendar with monthly tear-off sheets.

F. AND A. PARKINSON, Limited, Guiseley, Leeds.—Folder house circular entitled "Alternations."

USKSIDE ENGINEERING COMPANY, Limited, Newport, Mon.—Wall calendar with monthly tear-off sheets.

W. H. WILLCOX AND CO., Limited, 38, Southwark-street, S.E. 1.—Wall calendar with monthly tear-off sheets.

IRONITE COMPANY, Limited, 11, Old Queen-street, Westminster, S.W. 1.—Wall calendar with monthly tear-off sheets.

NOBEL INDUSTRIES, Limited, Nobel House, Buckingham-gate, S.W. 1.—Desk blotter with memorandum block attached.

STANLEE SHIPBREAKING AND SALVAGE COMPANY, Limited. H.M. Dockyard, Dover.—Wall calendar with monthly tear-off sheets.

WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Limited, 82, York-road, King's Cross, N. 1.—Wall calendar with monthly tear-off sheets.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 2, Norfolk-street, Strand, W.C. 2.—Art calendar with monthly tear-off sheets.

D.P. BATTERY COMPANY, Limited, Bakewell, Derbyshire.—Wall calendar, monthly tear-off slips. Picture of the river Derwent near Ambergate.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Limited, 8, Great George-street, Westminster, S.W. 1.—Art calendar with monthly tear-off sheets.

HUNT, BARNARD AND CO., Limited, Granville Works, Aylesbury.—Desk blotter with 1924 calender. Wall calendar with monthly tear-off sheets.

BEECROFT AND PARTNERS, Limited, St. Peter's Close, Sheffield.—Wall calendar with monthly tear-off sheets. Views of departments are shown in print.

JOSEPH WESTWOOD AND CO., Limited, Napier Yard, Millwall, E.—Wall calendar with a view of Westminster Hall roof, showing some of the repair operations.

J. I. THORNYCROFT AND CO., Limited, Thornycroft House, S.W. 1.—Desk calendar with monthly tear-off sheets, and pocket note wallet and stamp case.

STAVELEY COAL AND IRON COMPANY, Limited, Staveley Works, near Chesterfield.—Pocket diary with memorandum book and book of information in cover.

INDUSTRIAL LEAGUE AND COUNCIL, 82, Victoria-street, S.W. 1.—Copy of the diary issued by the Council at 2s. 6d. Much useful information is embodied therein.

LAUNCHES AND TRIAL TRIPS.

KIETSA, motor ship; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the British India Steam Navigation Company, Limited; dimensions, 287ft. by 40ft. beam; 1650 tons deadweight. Engines, reversible marine oil constructed by the builders; launch, December 21st.

ISLINGTON, self-trimming collier; built by Swan, Hunter and Wigham Richardson, Limited, to the order of H. Harrison (Shipping), Limited; dimensions, 240ft. by 37ft. 2in. by 19ft. 9in.; 2250 tons deadweight. Engines, triple-expansion, pressure 180 lb.; constructed by McColl and Pollock, Limited; launch, January 4th.

ORADELL, steel screw steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Ronde Steamship Company, Limited; dimensions, 254ft. 6in. by 35ft. 6in. by 16ft.; to carry fruit cargoes. Engines, triple-expansion, direct-acting, surface-condensing, pressure 200 lb.; constructed by the builders; launch, January 8th.

STEEL screw steamer; built by the Goole Shipbuilding and Repairing Company, Limited, to the order of James Hargreaves and Sons (Leeds), Limited; dimensions, 200ft. by 32ft. by 14ft. 6in. Engines, triple-expansion, 16½in., 27in., 44in. by 33in., pressure 180 lb.; constructed by the builders; launch, January 8th.

MINNETONKA, passenger liner; built by Harland and Wolff, Limited; to the order of the Atlantic Transport Company, Limited; dimensions, 625ft. by 80ft. by 53ft. 6in. Engines, Brown Curtis geared turbines, with single reduction gear, pressure 215 lb.; constructed by the builders; launch, January 10th.

LUXMI, single-screw motor vessel; built by Harland and Wolff, Limited; to the order of Andrew Weir and Co.; dimensions, 384ft. by 46ft. by 36ft.; 4320 gross tonnage. Engines, one set of six-cylinder Diesel; constructed by the builders; launch, January 19th.

SAN SALVADOR, steel single-screw tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Limited, at the Walker Shipyard; to the order of the Eagle Oil Transport Company; dimensions, length overall, 420ft. 6in.; between perpendiculars, 407ft.; breadth, moulded, 52ft.; depth, moulded to upper deck, 31ft. 6in.; to carry 8250 tons on a mean draught of 25ft. 3½in. Engines, triple-expansion, 27in., 45in. and 75in., with a stroke of 48in., pressure 180 lb.; constructed by the builders; boilers fitted with Howden's forced draught and arranged for oil burning on the White system; launch, January 22nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. SAMSON CLARK, of East Molesey, Chairman of Samson Clark and Co., Limited, the advertising service agents, of Mortimer-street, W., asks us to state that he is not in any way connected with Mr. Samson Clark, of 63, Kent House-road, Sydenham, S.E., against whom a receiving order in bankruptcy was gazetted last Saturday.

WE are officially informed that Mr. Peter McMenemey, who has been associated for many years with the activities in London and on the Mersey of Cammell Laird and Co., Limited, has been appointed London representative for that firm's shipbuilding, ship-repairing and engineering works at Birkenhead. Mr. McMenemey will carry out these duties in conjunction with those which he at present discharges for the company.

T. W. BROADBENT, Limited, of East-parade, Huddersfield, ask us to state that Mr. G. M. Stevenson, of 136, Yardley Wood-road, Moseley, Birmingham, who had been their representative in Birmingham, has now ceased to represent them, having commenced business on his own account. It is therefore requested that all inquiries and orders from Birmingham and district should in future be addressed to the firm at its head offices in Huddersfield.

MESSRS. PREECE, CARDEW AND RIDER, of 8, Queen Anne's-gate, Westminster, S.W. 1, inform us that they have arranged shortly to take into partnership Messrs. E. Parry, B.Sc., M. Inst. C.E., M.I.E.E., &c., W. H. Grimsdale, C. W. Kennaway, M.I.E.E., and R. W. Weightman, M.I.E.E. Mr. Parry was for eight years chief electrical engineer to the New Zealand Government, and during the last 4½ years he has been engineer-in-chief to the English Electric Company, Limited. Mr. Grimsdale, Mr. Kennaway and Mr. Weightman have been members of the firm's staff for many years. The name of the firm will remain as heretofore.

CONTRACTS.

JOSEPH KAYE AND SONS, Limited, of Lock Works, Leeds, inform us that they have just received a contract from the Admiralty for a further supply of their seamless serrated steel (valve) oilcans, for delivery in April.

THE GENERAL ELECTRIC COMPANY, Limited, has recently received a portion of a contract for the supply of gas-filled lamps to the Midland Railway during the period January 1st to June 30th, 1924.

PHYSICS IN INDUSTRY.—The sixth of the series of public lectures on this subject being delivered under the auspices of the Institute of Physics, will be given by Dr. C. H. Desch, F.R.S., Professor of Metallurgy in Sheffield University. The subject will be "The Physicist in Metallurgy," and the lecture, which will be illustrated, will be given in the rooms of the Chemical Society, Burlington House, Piccadilly, W., on Wednesday, February 6th, at 5.30 p.m. Sir Charles Parsons, President of the Institute, will preside. No ticket of admission will be required.

THE GEORGE MONTEFIORE FOUNDATION PRIZE.—The George Montefiore Foundation Prize, which is paid out of the accumulated interest of a sum of 150,000f. invested in 3 per cent. Belgian Rentes, is awarded every three years. It is international in character, and is awarded for the best original thesis on the advance of science and on the progress in the technical applications of electricity for all purposes. The next prize will be awarded in 1925, and its value will be 22,500 Belgian francs. Particulars may be obtained from Monsieur L. Calmeau, secrétaire général, Association des Ingénieurs sortis de l'Institut Electrotechnique Montefiore, Rue Saint Gilles 31, Liége, Belgium.

THE BRITISH CAST IRON RESEARCH ASSOCIATION.—The Council of the British Cast Iron Research Association has appointed Mr. J. G. Pearce to the post of director, in succession to Dr. Percy Longmuir. The new director will take up his duties to-day. Mr. J. E. Fletcher, M. I. Mech. E., who has been appointed consultant to the Association, will take special care of the practical side of cast and malleable iron research and will deal with the problems directly associated with the practice of members.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	19/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	24/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 8 9	—
No. 1 Foundry	5 10 0	—
No. 3 Foundry	5 0 0	—
N.E. COAST—		
Hematite Mixed Nos.	5 2 6	5 2 6
No. 1	5 3 6	5 3 6
Cleveland—		
No. 1	5 1 0	5 1 0
Silicious Iron	5 1 0	5 1 0
No. 3 G.M.B.	4 18 6	4 18 6
No. 4 Foundry	4 18 0	4 18 0
No. 4 Forge	4 15 0	4 15 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	
North Staffs. Forge	4 10 0 to 4 12 0	
,, ,, Foundry	4 17 6	—
(3) Northampton—		
Foundry No. 3	4 13 6 to 4 15 0	
,, Forge	4 7 6	—
(3) Derbyshire—		
No. 3 Foundry	4 15 0 to 4 17 6	
Forge	4 8 0 to 4 10 0	
(3) Lincolnshire—		
No. 3 Foundry	4 15 6	—
No. 4 Forge	4 14 0	—
Basic	4 15 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 15 0 (a) to 6 0 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best ,,	—	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	12 10 0	—
Second Quality Bars	11 15 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	12 10 0 to 12 15 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 5 0 to 11 10 0	
Gas Tube Strip	12 17 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ¼in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 9/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light ,,	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Hoops	14 10 0	—
MANCHESTER—		
Bars (Round)	10 10 0 to 10 15 0	
,, (others)	10 5 0 to 10 7 6	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 10 0	—
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 10 0	—
MIDLANDS—		
Small Rolled Bars	10 15 0 to 11 0 0	
Billets and Sheet-bars	8 0 0 to 8 5 0	
Gas Tube Strip	10 15 0 to 11 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0 to 18 10 0	
Angles	10 0 0	—
Joists	10 0 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/9 to 24/3
Block Tin (cash)	248 10 0
,, (three months)	249 10 0
Copper (cash)	61 12 6
,, (three months)	62 10 0
Spanish Lead (cash)	31 7 6
,, (three months)	31 12 6
Spelter (cash)	35 5 0
,, (three months)	34 0 0
MANCHESTER—	
Copper, Best Selected Ingots	67 10 0
,, Electrolytic	69 0 0
,, Strong Sheets	95 0 0
,, Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 1 0
,, Condenser	0 1 2½
Lead, English	33 15 0
,, Foreign	32 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton. £ s. d.	Per Unit. £ s. d.
Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
,, 6 p.c. to 8 p.c. ,,	£22 10 0	8/-
,, 8 p.c. to 10 p.c. ,,	£21 10 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£45 0 0	18/-
,, ,, 1 p.c. ,,	£54 0 0	21/-
,, ,, 0.75 p.c. carbon	£65 0 0	22/6
,, carbon free	1/6 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£17 for home, £19 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 5 0 scale 5/- per unit	
,, ,, 75 p.c.	£18 10 0 scale 6/- per unit	
,, Vanadium	20/- per lb.	
,, Molybdenum	7/6 to 8/- per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£130	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	25/-
,, ,, Ell	26/-
,, ,, Splint	26/6 to 28/-
,, ,, Trebles	26/6
,, ,, Doubles	25/-
,, ,, Singles	22/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	25/-
,, ,, Splint	26/6
,, ,, Trebles	26/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	23/- to 25/6
Screened Navigation	29/-
Trebles	27/6
Doubles	25/-
Singles	23/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	25/6
Secondary Steam	23/6
Trebles	27/-
Doubles	25/-
Singles	23/-

ENGLAND.

(8) N.W. COAST—	
Steams	29/-
Household	48/- to 59/-
Coke	41/-
NORTHUMBERLAND—	
Best Steams	25/6
Second Steams	23/-
Steam Smalls	15/-
Unscreened	22/-
Household	25/- to 28/-
DURHAM —	
Best Gas	24/6 to 25/-
Second	23/- to 23/6
Household	26/- to 28/-
Foundry Coke	40/- to 42/-

SHEFFIELD —	Inland.
Best Hand-picked Branch	35/- to 36/- —
Barnsley Best Silkstone	30/6 to 32/- —
Derbyshire Best Brights	30/- to 32/- —
,, ,, House	26/- to 27/- —
,, ,, Large Nuts	24/6 to 25/6 —
,, ,, Small ,,	18/6 to 20/6 —
Yorkshire Hards	24/- to 26/- —
Derbyshire ,,	23/- to 26/- —
Rough Slacks	12/6 to 13/6 —
Nutty ,,	10/- to 12/- —
Smalls	7/- to 9/- —
Blast-furnace Coke (Inland)	27/- to 29/-
,, ,, (Export) f.o.b.	35/- to 38/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	30/- to 31/-
Second ,, ,,	28/6 to 29/6
Best Dry Large	29/- to 30/-
Ordinary Dry Large	27/- to 28/-
Best Black Vein Large	28/- to 29/-
Western Valley ,,	28/- to 29/-
Best Eastern Valley Large	27/6 to 28/6
Ordinary ,, ,,	26/- to 27/-
Best Steam Smalls	23/- to 25/-
Ordinary ,,	20/- to 22/-
Washed Nuts	28/- to 30/-
No. 3 Rhondda Large	28/- to 29/-
,, ,, Smalls	25/- to 26/-
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 22/-
,, ,, Smalls	20/- to 21/-
Coke (export)	52/6 to 55/-
Patent Fuel	30/- to 32/6
Pitwood (ex ship)	28/- to 28/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	40/- to 42/6
Seconds	32/6 to 35/-
Red Vein	29/- to 30/-
Machine-made Cobbles	52/6 to 55/-
Nuts	52/6 to 55/-
Beans	42/6 to 45/-
Peas	26/- to 27/-
Breaker Duff	12/9 to 13/-
Rubbly Culm	13/6 to 14/-
Steam Coals:	
Large	24/6 to 25/-
Seconds	22/- to 23/-
Smalls	14/- to 16/-
Cargo Through	19/- to 21/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

† Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(*From our Correspondent in Paris.*)

How to Recover Trade.

THE industrial situation has become so complicated through the depreciation of French currency that attention is now centred entirely upon the possible means of providing a remedy. It cannot be said that there is a dislocation of business, as work is still fairly plentiful; but it is difficult to execute work when the financial sources are closed up and a steady advance in the cost of materials makes it impossible to fix selling prices with any certainty of realising profits. The fear is not so much for the present as for the future, when a possible collapse of the franc may undermine the foundation of the whole industrial edifice. At the same time the efforts being made to improve the franc aim not so much at bringing it back to something like the normal level as at stabilising it and at maintaining it at a fixed ratio to sterling. A too sudden improvement would be disastrous for industry by leaving manufacturing costs at a higher level than those prevailing in countries with a stabilised currency. The methods proposed for preventing fluctuations in money values are, curiously enough, just those which may serve as an impediment to trade development. The financial measures for ensuring a retrenchment of expenses and an increased revenue from taxation are obviously sound and necessary, but the idea of suppressing expenditure on foreign goods and products, when French manufacturers themselves have to sell in markets abroad, is a fallacy that must inevitably react against any tendency towards an improvement in money values. The only sure way of stabilising the franc, apart from the necessary internal financial reforms, is to encourage foreign commercial exchanges, so that French manufacturers will be able to sell, and when commercial interests are involved in a profitable exchange of goods and merchandise, the money values are bound to adjust themselves in a definite ratio. There are many far-seeing people in this country who are fully aware that the future lies very largely in an active foreign trade development, and they are equally convinced that such a development cannot take place unless other countries facilitate business by means of temporary measures which will help to bridge over the wide gap created by the discrepancy in money values.

The French Point of View.

A striking example of the state of things brought about by the heavy depreciation of the franc is observable in the agricultural engineering industry, of which the annual exhibition is being held in the Grand Palais, Paris. As agriculture is by far the greatest national industry and cannot be carried on profitably without increasing supplies of machinery, which have to be obtained largely from abroad, it might have been supposed that agricultural machinery would be the least affected by the exchange rate. Machinery must be employed for the reaping of grain, and this can only be supplied in sufficient quantities by British and American firms. Farmers, therefore, might be expected to pay the price, however high it may be. An inquiry amongst agents for British and American firms, however, revealed a feeling of resentment which is general throughout the country, and is due to the belief that Britain has organised her finances without any regard to her real interests, or to the interests of other countries. The French idea is that Britain has sacrificed everything to credit. If anything is to be done to facilitate relations between the two countries, it is well that the French point of view should be clearly understood. In the opinion of people here there was no necessity for any one country to restore credit and hinder trade when it would have been better to build up the trade first as a basis for international credit. A policy of co-operation between France and Britain would have sufficed to bring about the desired result. Unfortunately, the history of the past year has shown that co-operation implies an adherence to French policy which, as practised at the present moment, is so widely divergent from British ideas as to become irreconcilable. In a general way, therefore, the situation is at a deadlock, and no solution appears probable until the Allied inquiry into Germany's ability to pay suggests means for a final settlement. Until then any solution of the industrial crisis appears hopeless. At the Paris Show of Agricultural Machinery the fluctuations of the exchange rate, and the uncertain future, made it quite impossible for sellers to fix prices. One of the biggest firms of harvesting machinery refused to quote at all. Even the French quoted with certain restrictions, and in all cases the French prices were advanced, with the result that the farmer, who is in greater need than ever of labour-saving machinery, found himself in the unusual position of forcing upon sellers orders which these latter were by no means anxious to accept.

Industrial Co-operation.

The opinion was freely expressed by French agents at the Paris Agricultural Machinery Show that unless some arrangement could be come to for stabilising the franc, the business would necessarily pass entirely into French hands. They are already monopolising the business in tillage implements, as well as in most requirements except harvesting machinery, in which they are, nevertheless, making considerable headway. One importer of English gas engines pointed to what was being done by certain French firms, whose gas engines showed a considerable advance on anything previously turned out in this country. However great may be the superiority of English gas engines over the French, users here will not pay an equivalent of more than 30 per cent. over the prices of French engines. The problem that interests British firms is, therefore, to stabilise the franc at a figure which will enable them to sell their machines in this country. Agents are generally of the opinion that with the pound sterling at 65*f.*, there would be a parity between British and French prices. There are, of course, other factors to be taken into consideration, such as the proposed increased import duties as a means of producing more revenue; but, on the whole, the steady augmentation of manufacturing costs in this country must eventually assist in an equilibrium of prices, which will open up the way for an interchange of goods.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

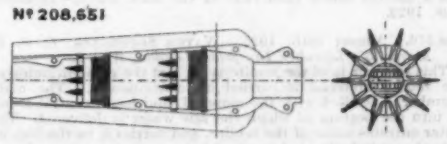
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

208,651. January 13th, 1923.—SILENCERS, J. Stirling, jun., Broomloe, The Avenue, Watford.

This exhaust silencer consists of a casing externally streamlined; that is to say, bulbous in front and tapering off to the rear, where it terminates approximately of the diameter of the exhaust pipe. The casing is provided externally with a number of radial fins, the leading ends of which are rounded to merge

Nº 208,651



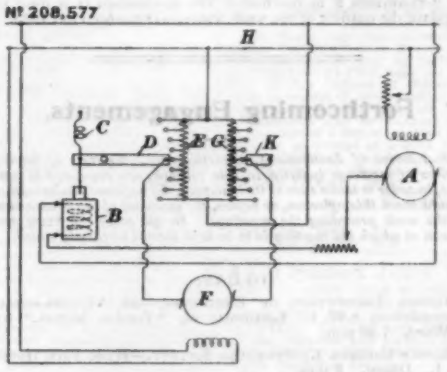
in the bulbous end of the casing. The interior of the casing is provided at intervals with transverse baffle plates of axially directed stream line cross section. The effect of the external stream-line configuration of the exhaust silencer is to create a reduction of pressure immediately behind the silencer, thus promoting the discharge of the gases therefrom, whilst the radial fins cool the silencer, and thereby the exhaust gases, thus reducing the volume of the latter.—*December 27th*, 1923.

TURBINE MACHINERY.

208,577. August 18th, 1922.—ELECTRIC GOVERNOR FOR PRIME MOVERS, Adolph Harry Railing, Max Ludwig Kahn and Robert Gordon Jakeman, of Magnet House, Kingsway, London, W.C. 2.

This invention relates to improved means for controlling the speed of prime movers. Centrifugal governors, as used on steam turbines and other prime movers, at present can be adjusted to work over a range of about 20 or 25 per cent. of full speed. In the case of prime movers driving ship propellers, either direct or through mechanical or electrical reduction gears, a wider range of speed is required. It is proposed to obtain the desired range of speed control by means of an electric governing gear. A small generator A is directly coupled to, or is otherwise driven by the prime mover, so that the speed of this generator equals, or is proportional to, the speed of the prime mover. This generator supplies current to a solenoid B or a torque motor or similar apparatus, the action of which is counterbalanced by a spring C or weight, and, by means of a rack and pinion or through a lever movement D. This solenoid operates a

Nº 208,577



potentiometer regulator E, which is arranged to control the supply of current to a motor F, which works the steam valve, in the case of steam-driven prime movers, or controls the oil or gas or other supply in the case of other prime movers. Two potentiometer regulators E and G are energised from a direct-current supply H, one of these E being the regulator above referred to and the other G is an auxiliary regulator, and the two are connected in parallel. The electric motor F, which is separately excited from the direct-current supply, has its armature connected to the movable contacts of the potentiometer regulators E and G. If the two points to which the motor is connected are of equal potential, no current will flow through the motor armature. If one of the points to which the motor is connected is moved from the position of equal potential, current will flow through the motor armature, causing it to revolve. Arrangements are made so that as the motor F revolves the contact arm K of the second potentiometer regulator G is moved in such a way that it tends to follow the movements of contact arm D until the two arms are equal in potential, thus stopping the motor F.—*December 18th*, 1923.

TRANSFORMERS AND CONVERTERS.

198,347. April 26th, 1923.—AN IMPROVED PROCESS FOR THE AUTOMATIC CONNECTION OF AN INSTALLATION EQUIPPED WITH LARGE MERCURY VAPOUR RECTIFIERS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

The automatic scheme for mercury vapour rectifiers described in this specification will be understood from the accompanying diagram. A is the primary network. B the main switch by which the transformer C that feeds the rectifier D is connected to the network. The system may be single-phase or polyphase as regards both its primary and secondary. By rotating the hand wheel E, the switch B is closed by means of the toothed gearing, and thus the primary winding of the transformer C is energised. At the same time, another switch is closed, thus closing the circuit of the time relay G, which is connected to the auxiliary network H. This relay actuates the switch I, whereby the relay J receives current from the network. The relay actuates the switch K, which switches in the auxiliary load resistance L between the zero point of the secondary winding of the transformer and the cathode M of the rectifier. At the same time as the switch K closes, the switch M also is closed, and thereby the time relay N fed from the network is brought into action. This relay closes the switch O after the expiration of a certain amount of time, and thus also closes the circuit of the relay P, which brings in the switches Q. One of these switches serves at the same time for switching in the ignition device R and for switching in the exciting device S. When the igniting anode and

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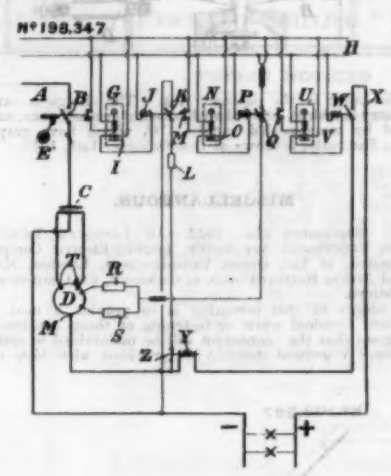

the exciting anode receive current by this means, a current will flow also through the working anodes T, and this current at first passes only through the auxiliary load resistance L. The time relay U now also receives current from the network, and after the expiration of the pre-determined time it actuates the switch V, and through it the relay W. This relay now switches in the secondary main switch X, by which the rectifier is switched on to the secondary network, marked + and −. The direct current delivered into the direct-current network flows, however, through the relay Y, which opens the switch Z, and thereby cuts out the auxiliary load resistance.—*December, 27th*, 1923.

PUMPING AND BLOWING MACHINERY.

208,582. September 16th, 1922.—VARIABLE DELIVERY PUMPS, G. Constantinesco, Carmen Sylva, Beechwood-avenue Oatlands Park, Weybridge.

In this pump the two pistons E and F are driven by the crank B. Two other pistons, in communicating cylinders, are connected with a pendulum V. The inlet valves are marked K and L, and the delivery valves O and P. Supposing that the pump cylinders G H M N are filled with liquid, together with the other pipes in the system, then for any given oscillation of the pump pistons E F the liquid will transmit movement to the lever U and mass V. Since the liquid columns are relatively short, the liquid will practically operate as a flexible connecting-rod. If the frequency of the pump piston increases, the inertia of the mass V will oppose considerable reactance to the motion, and considerable pressures will be generated in the pump cylinders. When there is no delivery from the pump, these pressures will be greater or less, according to the speed of the pump pistons E F, but the displacements of the point of connection X to the inertia device will always be the same as the displacement of the pump pistons E F. When the pump is delivering liquid the pressures diminish and the displacement of the pendulum will be less than that of the pump pistons E F. At each suction

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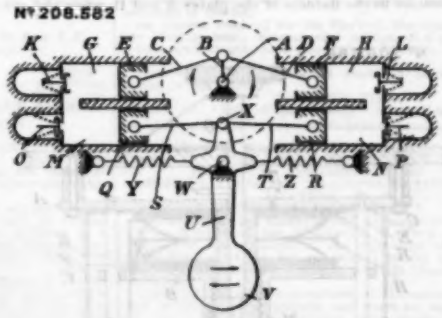


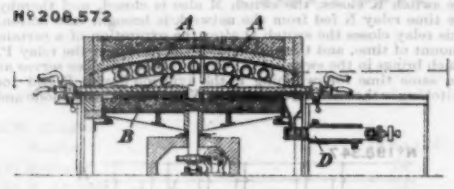
stroke of the pump piston a fall of pressure will take place on the corresponding side of the piston. The inertia device, however, will not be able to follow the liquid column immediately, and thus the suction valve on that side will open and liquid will enter the cylinder. On the pressure stroke of the pump piston, the pressure generated will not be able to move the inertia device immediately, and some liquid will therefore be discharged through the delivery valve, if the back pressure is not higher than the pump pressure. If the back pressure rises to a certain limit, the delivery valve will not open, and the inertia device will then simply be kept swinging to and fro, with its maximum stroke, the motion going on without any absorption of power by the prime mover driving the pump, except to overcome friction. When, however, the back pressure diminishes, for example, by utilising the liquid, the delivery valve will again open and work will be done by the prime mover depending on the amount of flow. It will be readily seen that the maximum pressure obtained at the delivery valves for constant flow is a function of the frequency of the pump, and therefore by speeding up or slowing down the prime mover, different maximum pressures may be obtained for the same flow.—*December 17th* 1923.

METALLURGY.

208,572. August 14th, 1922.—PRODUCTION OF SPONGE IRON, E. B. Thornhill and H. G. S. Anderson, Hurley, New Mexico.

This invention relates to the production of sponge iron for electrolytic and other purposes. It is said that the ore should be at least so fine that it will pass a 30 mesh screen, and it is mixed

with finely divided carbonaceous material, which should not contain more than 20 per cent. of volatile matter. The mixture is roasted in the furnace shown, which is heated by radiation,



with gas burnt in the passages A A. The charge is carried on a rotary hearth B, covered with a bed of crushed coke, and is agitated by water-cooled rabbles C C, which have graphite blades. The outlet is shown at D.—*December 14th*, 1923.

MISCELLANEOUS.

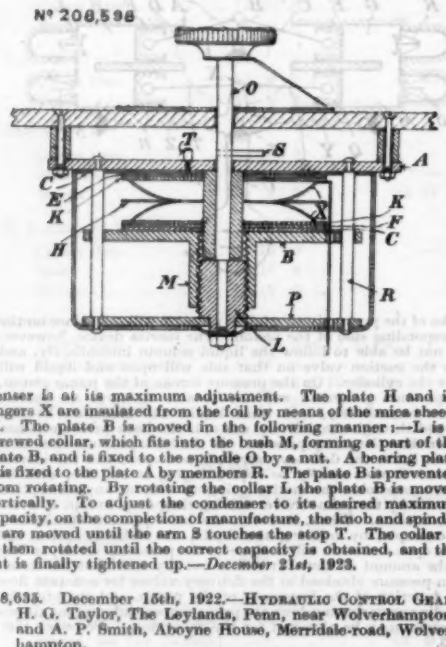
208,597. September 21st, 1922.—AN IMPROVED TERMINAL FOR ELECTRICAL APPARATUS, Igranic Electric Company, Limited, of 147, Queen Victoria-street, London, E.C. 4, and Arthur Herbert Curtis, of Caramore, 64, Chaucer-road, Bedford.

The object of this invention is to provide a neat and convenient terminal screw or fastening of cheap construction so designed that the connection will be maintained in spite of vibration. A screwed shank A is provided with lock nuts.

The head of the bolt is provided with a hole B. The spring C is U-shaped, and is made of a flat strip of metal folded to the form shown. Normally the groove or indent D in the upper limb of the spring is above the hole B, but if a wire is inserted in the hole, it is, if the spring be depressed as shown by the broken lines, nipped and firmly held securely against the sides of the hole even if the apparatus is subjected to considerable vibration.—*December 21st*, 1923.

208,598. September 21st, 1923. IMPROVEMENTS IN AND RELATING TO VARIABLE ELECTRIC CONDENSERS, Frederick Kenneth Crowther and Radio Communication Company, Limited, of 34–35, Norfolk-street, Strand, London, W.C. 2.

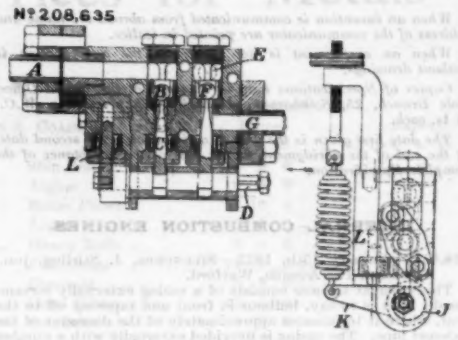
The plates A and B form the opposite sides of the condenser. The surfaces of these plates are covered with sheets of pressphn or other resilient material C. On the top of the pressphn there are pieces of copper foil E F, which form the active surfaces of the condenser plates. The object of the pressphn is to form resilient surfaces, which will compensate for any slight inaccuracies in the flatness of the plates A and B, when the con-



denser is at its maximum adjustment. The plate H and its fingers X are insulated from the foil by means of the mica sheets K. The plate B is moved in the following manner:—L is a screwed collar, which fits into the bush M, forming a part of the plate B, and is fixed to the spindle O by a nut. A bearing plate P is fixed to the plate A by members R. The plate B is prevented from rotating. By rotating the collar L the plate B is moved vertically. To adjust the condenser to its desired maximum capacity, on the completion of manufacture, the knob and spindle O are moved until the arm S touches the stop T. The collar L is then rotated until the correct capacity is obtained, and the nut is finally tightened up.—*December 21st*, 1923.

208,635. December 15th, 1922.—HYDRAULIC CONTROL GEAR, H. G. Taylor, The Leylands, Penn, near Wolverhampton, and A. P. Smith, Aboyne House, Merridale-road, Wolverhampton.

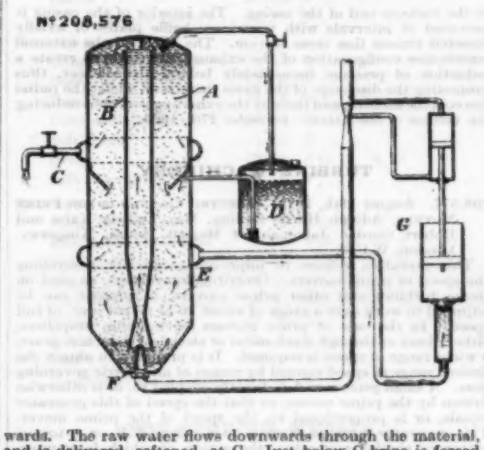
This hydraulic valve is intended to limit the pressure applied to the machine, the supply to which it controls. The inlet is shown at A. The ball valve B controls the passage of the water or oil, but can be opened by the pusher rod C, which is raised by the manually operated cam shaft D. The exhaust from the machine comes into the valve at E, and passes through another ball valve F on the way to the outlet G. The cams shaft is mounted in an excentric housing J, which is anchored by a spring and lever K. A small plunger L, communicating with the inlet passage, bears on the lever K, and turns the housing J in the event of excessive pressure. In this way the support to the ball valve B is released, and it is closed by the hydraulic



pressure, but the exhaust valve F can still be opened, as its cam has a greater throw than that of the inlet valve.—*December 27th*, 1923.

208,576. August 16th, 1922.—WATER SOFTENERS, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

This softener is of the zeolite type, and the reconditioning of the zeolite material is carried on continuously. The main chamber A is filled with the material, and has a central trunk B, into the bottom of which the raw water is delivered. The water entrains some of the zeolite, and carries it to the top, so that the main body of the material is constantly moving down-



wards. The raw water flows downwards through the material, and is delivered, softened, at C. Just below C brine is forced into the softener from the container D, and also flows downwards to another outlet E. In its passage it regenerates the descending zeolitic material. The regenerated material is finally washed, to free it of brine, by an ascending current of raw water, supplied by perforations F in the inlet. The mechanism G is used to regulate the outflow of the wash water.—*December 17th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, Westminster, S.W. 1. Lecturette on "Torsion Meters," by J. Ward. 7.30 p.m.

KING'S COLLEGE ENGINEERING SOCIETY.—Hyde Park Hotel, W. 1. Dance. 9 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse on "Recent Research in Crystalline Structure," by Sir William Bragg, F.R.S. 9 p.m.

UNIVERSITY COLLEGE, LONDON, ENGINEERING SOCIETY.—The College Refectory, Gower-street, W.C. 1. Annual Dinner and Conversazione.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, S.W. 1. Informal meeting. Discussion, "The Possibility of Main-line Electrification in Great Britain," introduced by Mr. H. H. Johnson. 7 p.m.

SATURDAY, FEBRUARY 2ND.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Aytoun-street, Manchester. A lecture, entitled "Some Foundry Reminiscences," by Mr. R. Buchanan, F.R.S.A. 4 p.m.

MONDAY FEBRUARY 4TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Reaction Turbines," by Mr. F. K. Skevington. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2.—Cantor Lecture III., "Colloid Chemistry," by Dr. E. K. Rideal. 8 p.m.

SOCIETY OF CHEMICAL INDUSTRY AND CHEMICAL ENGINEERING GROUP.—The Engineers' Club, 39, Coventry-street, W. 1. Paper, "The Manufacture of Potash and other Salts from Leucite," by Professor J. W. Hinchley. 8 p.m.

SOCIETY OF ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, W. 1. Presidential address by Mr. G. A. Becks. 5.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION.—Neville Hall, Newcastle-upon-Tyne. Paper, "Coaling Appliances at the Tyne Improvement Commissioners' Docks," by Mr. E. G. Wilson. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. General meeting. 5 p.m.

TUESDAY, FEBRUARY 5TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Papers, "Slips and Washouts on the Hill Section of the Assam-Bengal Railway," by Mr. T. R. Nolan; "Underdrainage and its Application to Railway Work," by Mr. R. D. Walker. 6 p.m.

WEDNESDAY, FEBRUARY 6TH.

INSTITUTE OF PHYSICS.—Rooms of the Chemical Society, Burlington House, Piccadilly, W. 1. Lecture, No. 6, "The Physicist in Metallurgy," by Professor C. H. Desch, F.R.S. 5.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Students' meeting. Paper, "The Bristol Waterwork—Past and Present," by Mr. F. W. S. Hawtayne. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section meeting. "Atmospherics and their Effect on Wireless Receivers," by Mr. E. B. Moullin. 6 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Paper, "The Life Present in a Stream and the Effects of Sewage and Various Trade Wastes on it," by Dr. W. Rushton. 7.30 p.m.

LIVERPOOL ENGINEERING SOCIETY.—9, The Temple, Dale-street, Liverpool. Paper, "Tramways," by Mr. T. Molyneux. 8 p.m.

NEWCOMEN SOCIETY.—Prince Henry's Room, Fleet-street, E.C. 4. Papers, "Reminiscences of John Braithwaite," by Sir George Greenhill, F.R.S.; "Chain of Pots, 6th to 7th Cent. A.D.," "Dredger of the Chain Pump Type, c. 1360," by Mr. F. G. Zimmer; "A Sixteenth Century Treadwheel for Raising Water," by Mr. H. A. Sandford; "Old Windmills in New England," by Mr. Edward P. Hamilton; "John Evelyn's MS. Circle of Mechanical Trades, 1660," by Mr. A. F. Sieveking. 5.30 p.m.

FRIDAY, FEBRUARY 8TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Some Physiological Aspects of Heating and Ventilation," by Mr. K. Gray. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Midland Hotel, Manchester. Anniversary dinner. 6.15 for 6.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "Recent Lights on the Minoan Art of Crete," by Sir Arthur Evans, F.R.S. 9 p.m.

SATURDAY, FEBRUARY 9TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE. Grosvenor Restaurant, Gordon-street, Glasgow. Smoking concert. 7 p.m.

TUESDAY, FEBRUARY 12TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—207, Bath-street, Glasgow. Joint meeting with Institution of Mechanical Engineers and Institution of Locomotive Engineers. Lecture on "Railway Electrification in Foreign Countries," by Professor S. Parker Smith, D.Sc. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—Institute of Marine Engineers, 85/88, The Minories, E. 1. Paper, "Some Chemical Aspects of Welding," by Mr. J. R. Boser. 7 p.m.

KING'S COLLEGE ENGINEERING SOCIETY.—Institution of Mechanical Engineers, Storey's Gate, S.W. 1. Anniversary meeting. "Economics as Applied to Mechanical Engineering," by Vice-Admiral Sir George Goodwin. 5.30 p.m.

WEDNESDAY, FEBRUARY 13TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Informal meeting. Discussion on: "The Capacity to be Provided in Service-Reservoirs," to be opened by Mr. H. J. F. Gourley. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to Stonebridge Park Power Station, London, Midland and Scottish Railway.

THURSDAY, FEBRUARY 14TH.

INSTITUTION OF CHEMICAL ENGINEERS.—Engineers' Club, Coventry-street, W. 1. Paper, "The Transport, Storage and Distribution of Hydrochloric Acid, with an Account of a Complete Modern Installation," by Mr. D. M. Newitt. 8 p.m.

FRIDAY, FEBRUARY 15TH.

DIESEL ENGINE USERS' ASSOCIATION.—Engineers' Club, Coventry-street, W. 1. Discussion, "Heavy Oil Engine Working Costs," based on the second report of the Committee of the Association.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Honorary members' lecture, "Some Suggestions for Road Transport Development," by Mr. D. S. Capper. 7.30 p.m.

INSTITUTION OF PUBLIC LIGHTING ENGINEERS AND SUPERINTENDENTS.—Board Room of Holborn Borough Council, 197, High Holborn, W.C. 1. Inaugural meeting. 2 p.m.

OLD CENTRALIANS.—Engineers' Club, Coventry-street, W. 1. Twenty-first annual dinner. 7 for 7.30 p.m.

TUESDAY, FEBRUARY 19TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, E. 1. "Experiments on a Cylindrical Steam Boiler with and without Pre-heated Air," by Mr. D. H. Owen. 6.30 p.m.

MANCHESTER METALLURGICAL SOCIETY.—College of Technology, Manchester. Paper, "The Inner Structure of Metals," by Messrs. F. C. Thompson and E. W. Millington. 7 p.m.

TUESDAY, FEBRUARY 26TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, E. 1. "Electricity as the Motive Power for Ships," by Mr. L. Rothera. 6.30 p.m.

WEDNESDAY, FEBRUARY 27TH.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Queen's Hotel, Birmingham. Annual dinner. 7 p.m.

A.M.I.E.E. EXAMINATION.—The next examination for Associate Membership of the Institution of Electrical Engineers will be held on April 3rd, 4th and 5th. Candidates must be either students or graduates of the Institution or have lodged with the secretary a duly completed form "E" for election as Associate Member. Entry forms for the examination, which must be completed and returned by March 1st, and particulars regarding election to membership of the Institution may be had on application to the Secretary, the Institution of Electrical Engineers, Savoy-place, Victoria Embankment W.C 2. The examination is being held this year about a fortnight earlier than in past years in order that those successful candidates who have qualified in other respects for Associate Membership may be elected before the session is over.